Waves and Energy Conservation! Year 9 Science at Home

You can help! Your child is learning how energy travels as waves — sound, light, heat — and about the important law that energy can never be created or destroyed, only transformed. These ideas are at the heart of all technology!

Why are we learning this? Waves and communication up here

In remote northern Australia, wave-based communication is critical to daily life. Radio waves carry community radio broadcasts that connect remote communities. Mobile phone signals travel as electromagnetic waves. Satellite communications bring internet to remote areas. Even traditional communication used wave principles — the didgeridoo creates complex sound wave patterns, and fire and smoke signals work partly through light and heat waves. Understanding how waves carry energy helps your child understand the technology that keeps their community connected to the rest of Australia.

My child will learn to:

✓ Describe wave properties
Identify wavelength, amplitude, frequency and wave speed as properties of waves.

✓ Distinguish wave types
Compare how sound (mechanical), light (electromagnetic) and heat (electromagnetic/conduction) transfer energy through different mediums.

✓ Apply the wave model
Use wave properties to explain phenomena like pitch, loudness, colour and refraction.

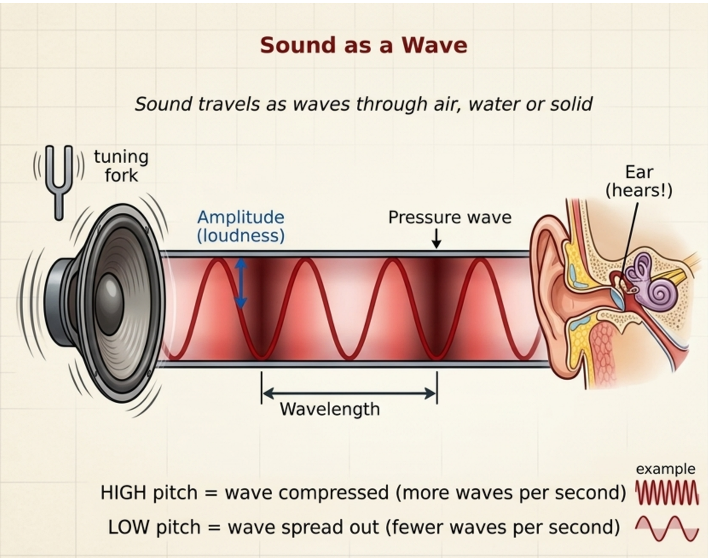
✓ Apply energy conservation
Explain why no system is 100% efficient using the law of conservation of energy.

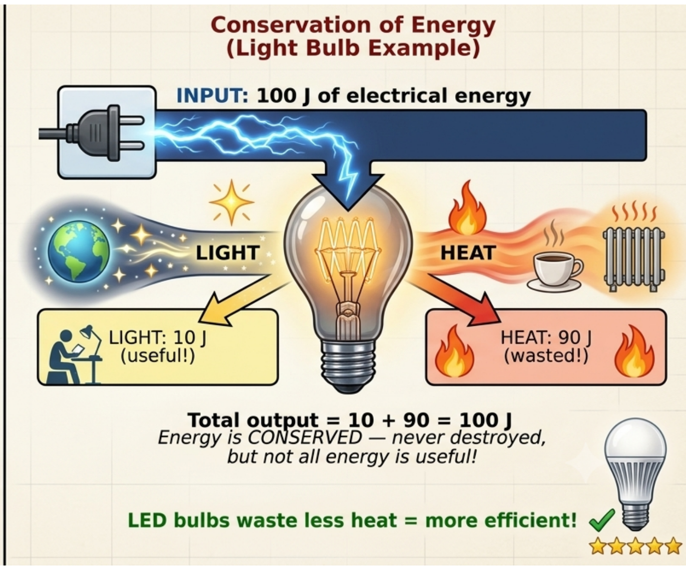
Big ideas to know:

Waves carry energy
A wave is a disturbance that transfers energy through a medium (or through space) without permanently moving the medium itself. Sound waves are vibrations moving through air, water or solids. Light and other electromagnetic waves (radio, microwaves, infrared, UV, X-rays) can travel through empty space. All waves have: wavelength (distance between peaks), amplitude (height of peaks = energy), and frequency (waves per second = pitch for sound, colour for light).

Sound vs light waves
Sound requires a medium to travel through — you cannot hear anything in a vacuum (space is silent). Sound travels at about 340 m/s in air, faster in water and solids. Light is an electromagnetic wave that can travel through empty space at 300,000,000 m/s — the fastest speed in the universe. Higher frequency = higher pitch (sound) or bluer colour (light). Higher amplitude = louder sound or brighter light.

Conservation of energy
The law of conservation of energy states that energy cannot be created or destroyed — only converted from one form to another. In every real system, some energy is converted to heat (thermal energy) that we cannot easily use. This is why machines are never 100% efficient. A diesel generator converts chemical energy to electrical, but about 70% becomes heat. A solar panel converts about 20% of light energy to electricity. The rest becomes heat in the panel.





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Types of waves and how they transfer energy

Wave type	What carries the wave	Speed	Example uses
Sound (mechanical)	Vibrations through air, water or solids	~340 m/s in air; faster in water	Speech, music, didgeridoo, sonar, ultrasound (medical)
Light (electromagnetic)	Oscillating electric and magnetic fields — no medium needed	300,000,000 m/s in vacuum	Vision, photography, solar panels, fibre optic internet
Radio waves (electromagnetic)	Oscillating fields — travels through air and space	300,000,000 m/s (light speed)	Community radio, mobile phones, satellite internet, GPS
Infrared (heat) radiation	Electromagnetic radiation	300,000,000 m/s	Feeling warmth from fire or sun, thermal cameras, remote controls
Microwaves (electromagnetic)	Oscillating fields	300,000,000 m/s	Microwave ovens, mobile phone signals, satellite TV

Think Like a Scientist — Wave Investigator

Try these two wave experiments: 1. Stretch a rubber band tightly between two fingers and pluck it. Now stretch it tighter and pluck again. What changes? (Frequency and pitch.) 2. Turn on a radio and move away from it. What happens to the sound? What is changing about the wave?

Ask: "What changes when we stretch the band tighter — the wavelength or the frequency? How does distance affect the amplitude (loudness) of the radio? If you could see the sound waves, what would they look like spreading out from the radio?"

Wave experiments to try:

1. Rubber band: tighter = higher pitch = higher frequency = shorter wavelength
2. Cup and string phone: pluck the string and feel vibrations through the cup
3. Clap near a wall and listen for the echo — sound bouncing back (reflection)
4. Tune a radio between stations: you will hear noise (waves from different stations)
5. Fill glasses with different amounts of water; tap with a spoon — note the pitch

Questions to ask your child

1. Why can you hear sound in air but not in outer space?
2. Why does a fire feel warm even when you are standing away from it and not touching it?
3. If you double the frequency of a sound wave, what happens to its pitch?
4. How does a radio station send music to your radio at home?
5. Why does sound travel faster through water than through air?
6. What does the law of conservation of energy say happens to all the energy that goes into a machine?
7. How is a Sankey diagram useful for showing the efficiency of an energy-converting device?

Your community radio station is a great real-world wave example. Ask: "How does the voice of the presenter get from their microphone into our home?" Trace the energy: sound wave (microphone) → electrical signal → electromagnetic radio wave (transmitted) → electrical signal (antenna) → sound wave (speaker). That's 5 energy transformations!

Key words to know:

Wave	A disturbance that transfers energy through a medium or space without permanently moving the medium
Wavelength	The distance between two consecutive peaks (or troughs) of a wave
Frequency	The number of waves passing a point per second — measured in Hertz (Hz)
Amplitude	The height of a wave from rest position to peak — higher amplitude = more energy
Electromagnetic spectrum	The full range of electromagnetic waves from radio waves (low frequency) to gamma rays (high frequency)
Conservation of energy	Energy cannot be created or destroyed — only transformed from one type to another
Efficiency	The proportion of input energy that becomes useful output energy — no system is 100% efficient

Key words to look up

Wave · Wavelength · Frequency · Amplitude · Electromagnetic spectrum · Conservation of energy · Efficiency

What school will check

By the end of Year 9, your child needs to use wave and particle models to describe energy transfer through different mediums and apply the law of conservation of energy to analyse system efficiency.

Try it at home!

At night, count how many seconds between a lightning flash and the thunder. Divide by 3 — that is roughly how many kilometres away the storm is. You are using the fact that light (electromagnetic wave) travels almost

		instantly while sound (mechanical wave) travels at only 340 m/s!