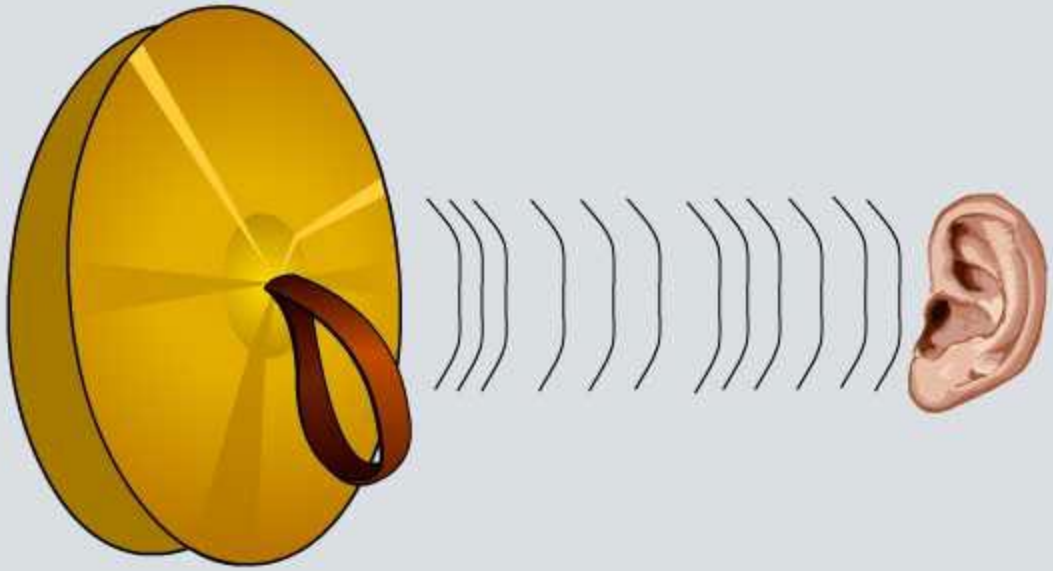
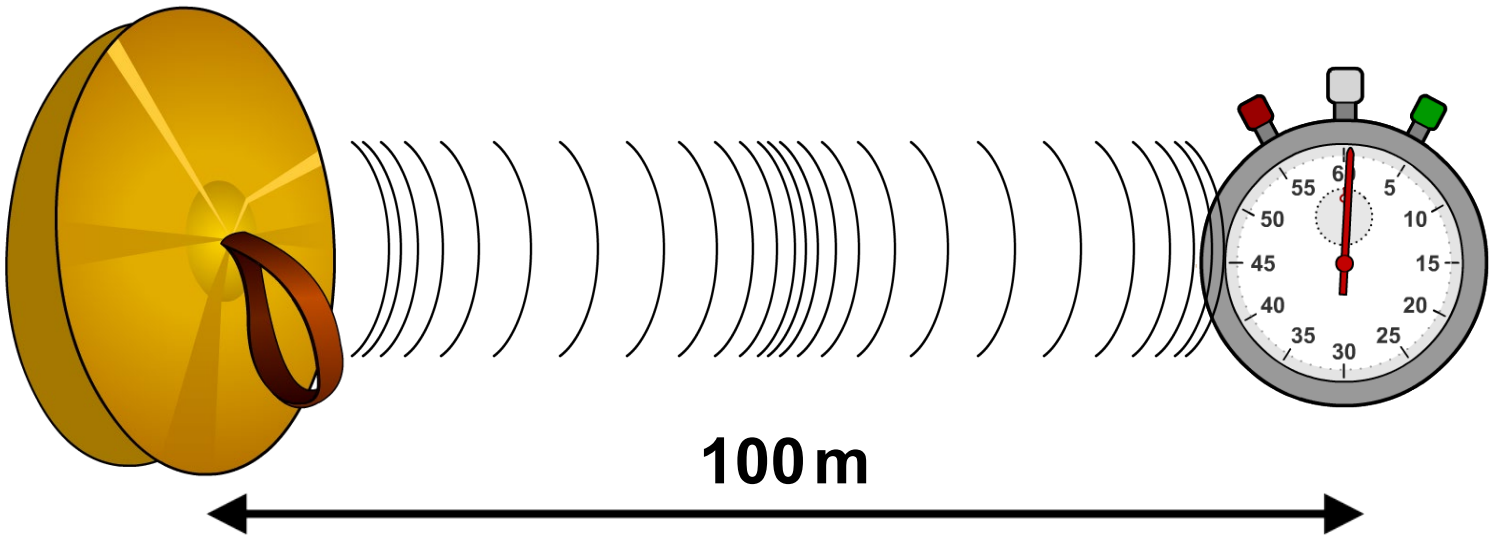
Speed of Sound



Speed of sound – experiment

This investigation for calculating the speed of sound should be carried out in a quiet, open space.

One student should hold a stopwatch, while another should be holding some cymbals 100 meters away.



1. When you **see** the cymbals crash, press start.
2. When you **hear** the cymbals crash, press stop.

Speed of sound – results

Record the results of the sound experiment in a table like this:

Experiment	Distance (m)	Time (s)	Speed (m/s)
1	100	0.34	294
2			
3			
4			

How are these values used to estimate the speed of sound?

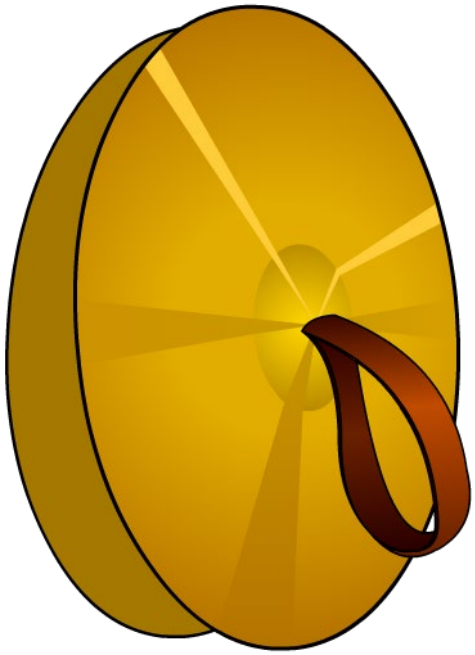
$$\text{speed} = \frac{\text{distance}}{\text{time}} = \frac{100}{0.34} = 294\,\text{m/s}$$

Speed of sound – analysis

The first cymbal experiment gives an estimate for the speed of sound as 294 m/s.

Use the average of your results to calculate another estimate for the speed of sound.

1. How does this calculation for the average speed of sound compare with the real speed?
2. What errors could have affected the results of the cymbals experiment?
3. Do you think the speed of sound in water is the same as the speed of sound in air?

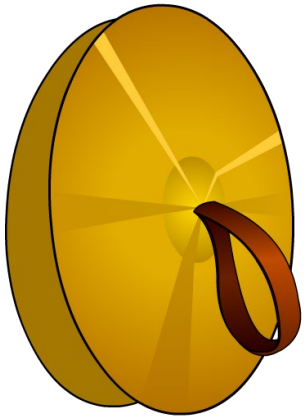


Energy transfer

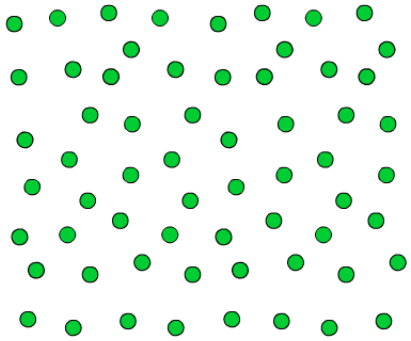
How many different energy transfers do you think take place during this experiment?

When the cymbals crash there is a transfer of kinetic energy from the cymbals to the air particles.

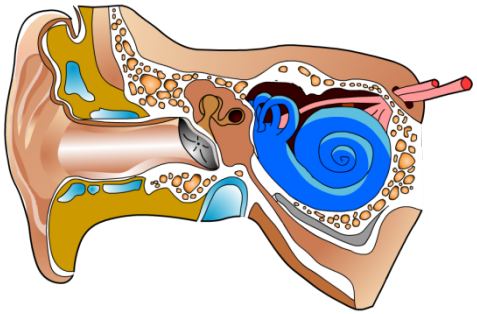
When the sound waves reach the ear, there is a transfer of kinetic energy from the air particles to the eardrum.



kinetic energy of cymbals



kinetic energy of air particles

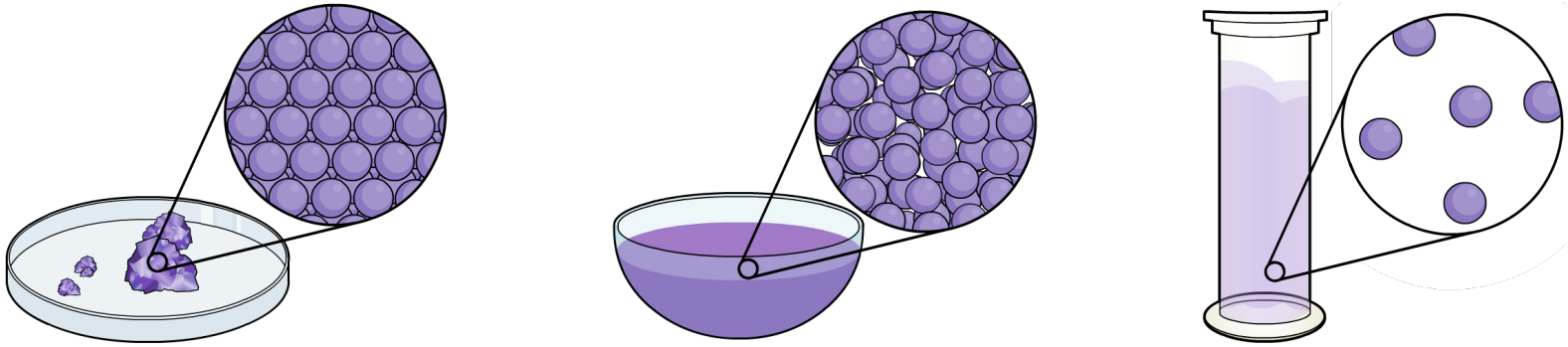


kinetic energy in eardrum

Sound in different materials

Sound needs a substance through which to travel because it travels by making particles vibrate.

Which state of matter does sound travel fastest through?



Sound waves travel fastest through solids.

The particles in a solid are closer together than in a gas, and more tightly bound than in a liquid. This means vibrations are more easily passed from particle to particle, and so sound travels faster.

Sound waves in different materials

How does sound travel through solids, liquids and gases?

Sound travels by the vibration of particles.

How does the state of the substance affect this?

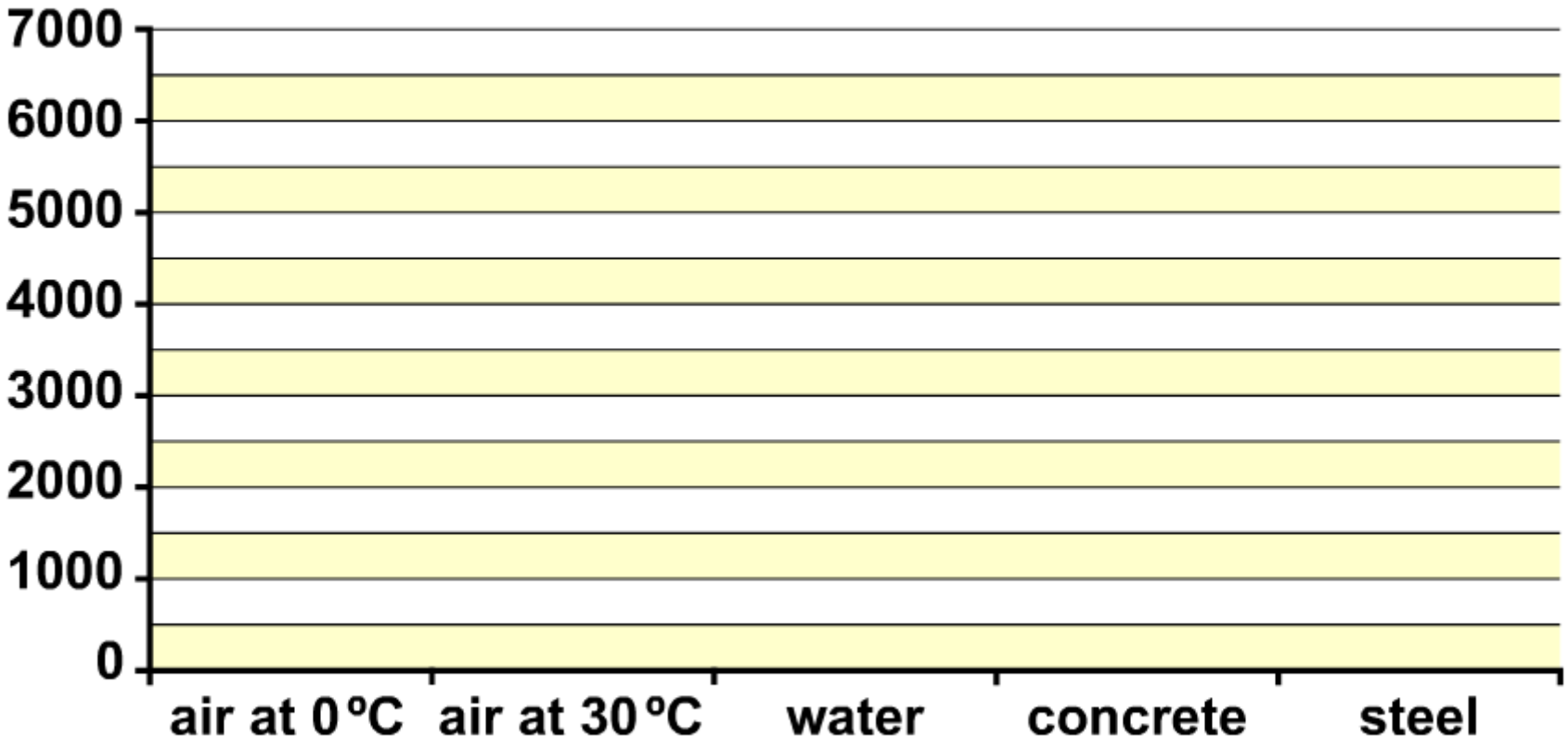
Click on each of the buttons on the left to see how sound travels through solids, liquids and gases.

start

Steel

Speed of sound in different materials

How do different materials affect the speed of sound?



Breaking the sound barrier

Which of these travel faster than the speed of sound in air?

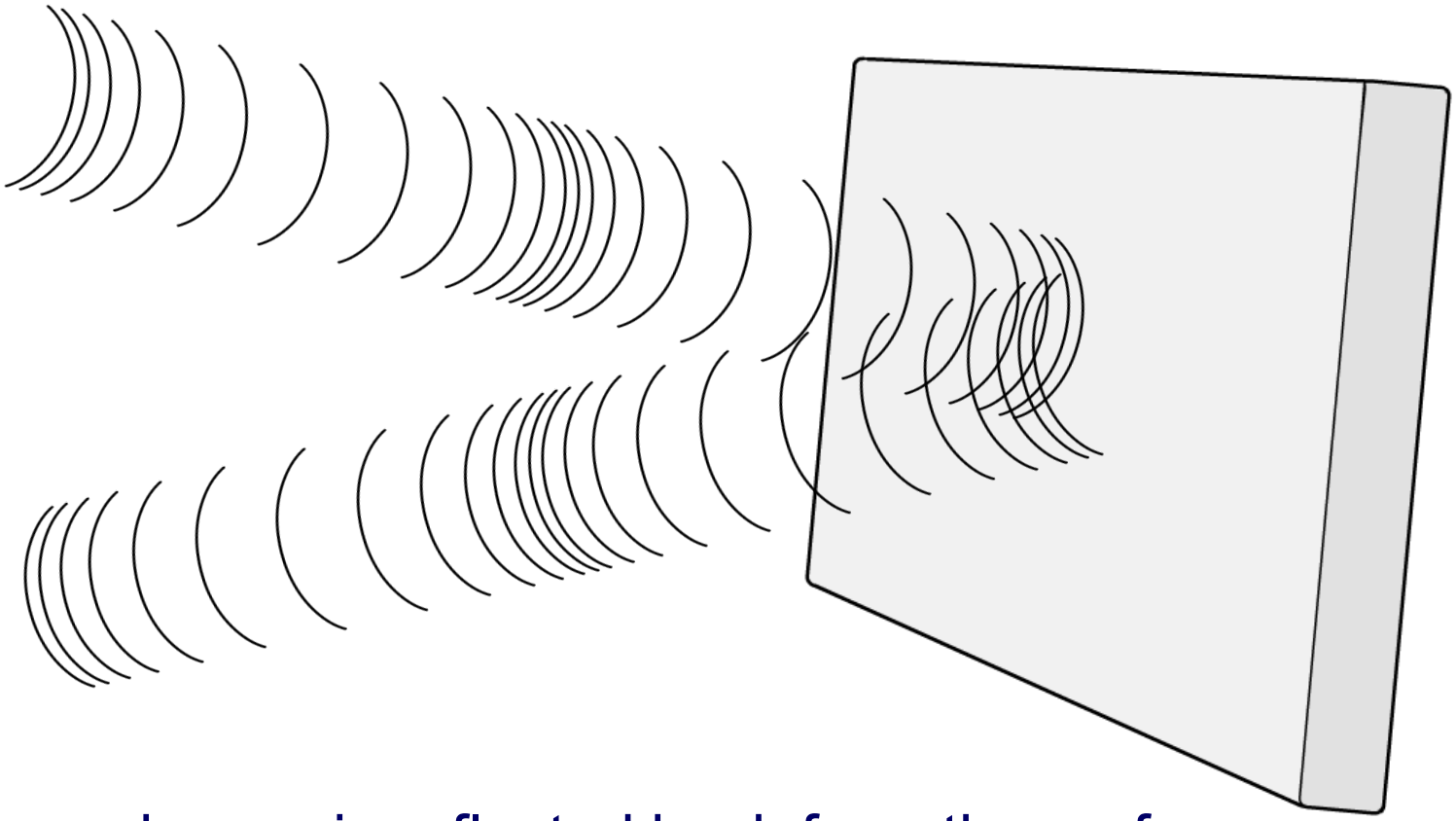
	Distance (m)	Time (s)	Speed (m/s)
small airplane	600	5	120
jet fighter	900	2	450
cheetah	50	2.5	20
meteorite	10,000	0.35	28,571.4

The jet fighter and the meteorite travel faster than the speed of sound in air.

This is called breaking the sound barrier.

Reflected sound

What happens when a sound wave meets a hard, flat surface?



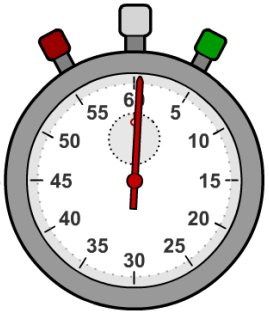
The sound wave is reflected back from the surface.

This is called an **echo**.

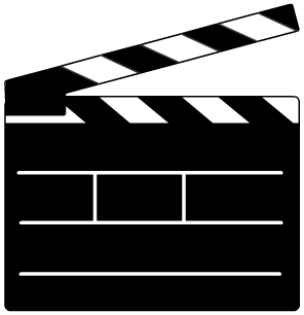
Investigating echoes

Plan an investigation to measure the speed of sound using echoes.

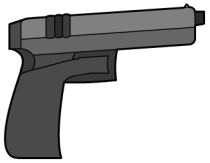
You may use any of the following equipment:



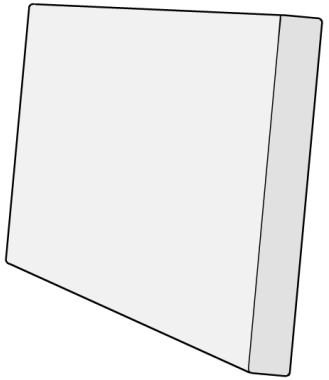
stopwatch



clapper board



starting pistol



hard, flat surface

Remember to make sure it is a fair test.

Analyzing your results

Calculate the speed of sound for each of your distances using the formula below.

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

1. How do your calculations compare with the actual speed of sound in air?
2. Which of your distances gave the most accurate answer?
3. Were there any errors in your experiment?
4. Could you improve the experiment in any way to make it even more accurate?