

Waves: demonstrating P and S waves with students

Key
stage
4/5

The scenario

In this scenario, the students are asked to imagine that they are the particles that make up a solid or a liquid; not atoms or molecules, just particles. By linking arms, and thus making bonds between each other, the students can demonstrate how P- and S-waves travel through a solid (with bonds) and a liquid (without bonds).

The activity

Demonstrating a longitudinal P-wave

1. Line 10 students up at the front of the classroom side by side with their feet a shoulder width apart.
2. Get each student to put their arms over the shoulders of the people they are next to, representing bonds between the rigid arrangements of particles (the students) in a solid.
3. Tell the students that you are going to push one end of the line, and that they should behave elastically, going with the push but returning to their original position.
4. Gently give the student on one end of the line a push.

As the wave propagates each student should move side to side, returning to the original position.

5. Now get the students to stand side by side with their arms by their side, representing the weaker bonds between particles in a liquid.
6. Again, gently push the student at one end of the line.

The wave will still propagate through the 'liquid'.

In both cases, the wave took a while to propagate (it has a speed) that was likely to be noticeably faster for the solid. The oscillations of the particles was in the same plane as the direction of propagation of the wave.

Learning objectives

- properties of longitudinal and transverse waves
- effect of bonds and particle arrangement on how a wave is transmitted in solids and liquids

Equipment needed

- about 10 students



Demonstrating a transverse S-wave

1. Line 10 students up at the front of the classroom side by side with their feet a shoulder width apart.
2. Get each student to put their arms over the shoulders of the people they are next to, representing bonds between the rigid arrangements of particles (the students) in a solid.
3. Tell the students that you are going to pull one of them forwards, and that they should behave elastically, going with the pull but then stepping back to return to their original position.
4. Gently give the student at one end of the line a pull forwards.

Once again, the wave will propagate through the solid, this time with the particles oscillating in a plane that is perpendicular to the direction of propagation.

5. Now get the students to stand side by side with their arms by their side, representing the weaker bonds between particles in a liquid.
6. Again gently pull the student on one end forwards.

This time, there is no transfer of wave energy. This transverse wave is not capable of travelling through a liquid.

Students can then discuss the effect of particle structure and bonds on the propagation of transverse and longitudinal waves.

