

# 24 Pulse-echo imaging – Part 2

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Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

## Vocabulary

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*Write each word three times.*

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| English      | Write it 3 times (English) |
|--------------|----------------------------|
| pulse-echo   | _____                      |
| reflected    | _____                      |
| coupling gel | _____                      |

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## Recall

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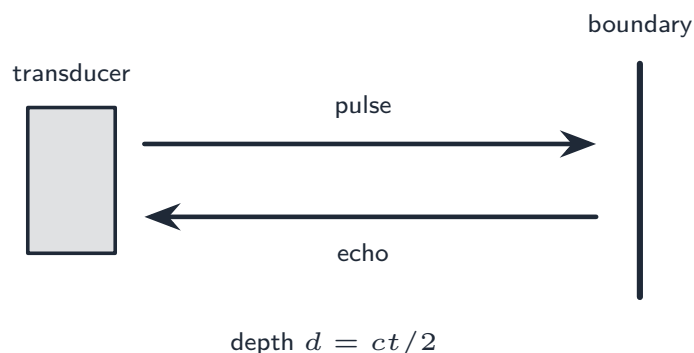
Ultrasound lets us see inside the body without surgery, using reflected pulses.

## New ideas

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Read these first. Each idea has a short worked example. Then do the Practice.

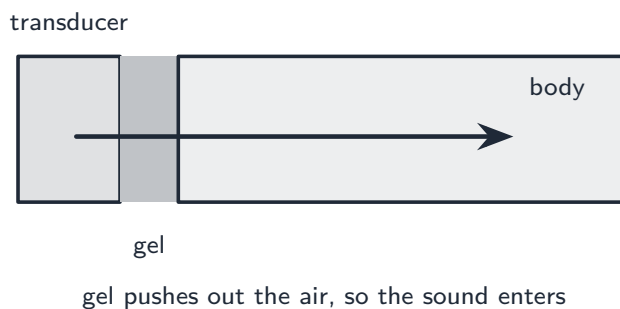
## ■ 1 Pulse-echo imaging



In **pulse-echo** imaging, the transducer sends a short pulse; part is **reflected** at each boundary. The time delay gives the depth:  $d = ct/2$  (there and back).

*Worked example.* An echo returns after  $t = 1.0 \times 10^{-4}$  s. With the speed of ultrasound in tissue  $c = 1500 \text{ m s}^{-1}$ :  $d = ct/2 = (1500)(1.0 \times 10^{-4})/2 = 0.075 \text{ m}$  – the boundary is 7.5 cm deep.

## ■ 2 Coupling gel



A **coupling gel** is put between the transducer and skin. Without it, almost all the ultrasound would reflect off the air and never enter the body.

*Worked example.* A thin layer of air between the probe and skin would bounce nearly all the ultrasound straight back. The gel fills that gap, so the pulse passes smoothly into the body.

**Watch out:** divide the time by 2 because the pulse travels to the boundary *and* back. Use the speed of sound in *tissue* (about  $1500 \text{ m s}^{-1}$ ), not in air.

## Practice

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Try these in order.

**24.1** In *pulse-echo* imaging, what is sent into the body? [1]

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**24.2** What happens to the pulse at a tissue boundary? [1]

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**24.3** Write the formula for the depth from the echo time. [1]

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**24.4** Why is the time divided by 2 in  $d = ct/2$ ? [1]

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**24.5** An echo returns after  $8.0 \times 10^{-5}$  s. The speed in tissue is  $1500 \text{ m s}^{-1}$ . Find the depth of the boundary. [2]

**24.6** Why is *coupling gel* used? [1]

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**24.7 Challenge.** Ultrasound is used to image a baby in the womb, but X-rays are not. Explain why ultrasound is the safer choice. [2]

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