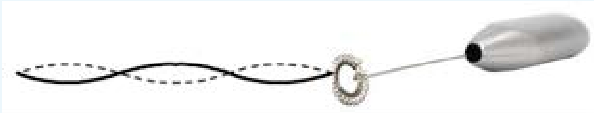
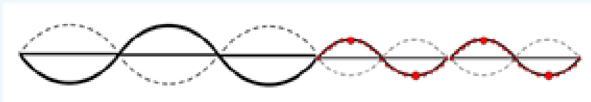
Refraction due to changing wave speed

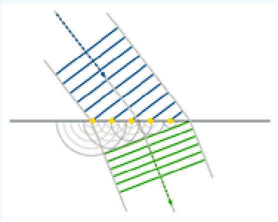
Background

When waves cross a boundary into a more dense medium they are refracted (change direction) due to a reduction in wave speed. In standing waves, two adjacent nodes on are separated by a distance of half a wavelength, $\lambda/2$.

The wave equation $v = f\lambda$ implies that if the frequency, f, stays constant, then a reduction in wavelength, corresponds to a reduction in wave speed.







You will need...

- ✓ A milk frother,
- ✓ elastic cord,
- ✓ bath-chain,
- ✓ an angler's swivel.
- ✓ small cable-ties.

Follow these steps

1. Attach the swivel to the frother by a small cable tie.
2. Attach one end of the elastic cord to the swivel, and the other end to the bath chain.
3. Stretch the chain and chord slightly in a horizontal line and switch on the frother.

So what happened?

A standing wave formed, with greater separation between the nodes in the white elastic cord, than occurred between the nodes on the bath chain. The frequency is constant throughout (determined by the frother). Therefore the closer separation of nodes in the bath chain (denser medium) is indicative of a reduced wave speed in the denser medium, which relates to the resultant change in direction in the top diagram.

What next?

Connect the frother at the opposite end to simulate waves entering a less dense medium.