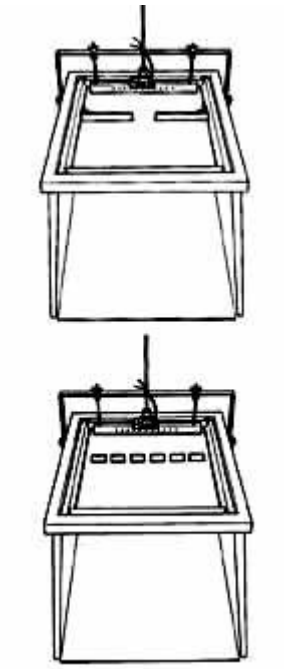
TAP 530- 4: Diffraction with water waves

Crystal diffraction can be simulated using water waves.



You will need:

- ✓ ripple tank (levelled)
- ✓ plane wave generator
- ✓ power pack 6 V
- ✓ rheostat to control speed of motor
- ✓ desk lamp for illumination
- ✓ barriers to provide at least 3 'holes'
- ✓ hand held stroboscopes

What to do:

1. First set up the ripple tank with about 1 cm depth of water.
2. Set up a line of small barriers 5 cm from the vibrator, as shown. There should be a gap of 2 to 3 cm between each.
3. Start the motor at a low speed (4 rev/second).

Ask: 'Can you see semicircular ripples emerging from the gaps? Further out, can you see waves moving out in slanting directions, as well as a wave moving straight ahead?'

Students should observe the diffraction pattern carefully, with and without stroboscopes.

Keeping the barriers arrangement the same, gradually increase the motor speed.

Ask, 'How does the diffraction pattern change?

	**Safety** Beware water on the laboratory floor. Make sure you have a sponge and bucket handy to mop up spills immediately. Place the power supply for the lamp on a bench, not on the floor by the tank

Practical advice:

You should refer back to the work in Episode 322: Diffraction gratings and Episode 323: Diffraction and particularly:

TAP 323-1: Ripple tank diffraction

The pattern produced with multiple gaps is less clear than the double gaps experiment but, with care in aligning the gaps, it is visible. It will help if students have first seen diagrams of sets of semicircles to represent a snapshot of waves proceeding from several gaps.

Avoid very high motor speeds, which cause unwanted vibration of the barriers.

The spacing of nodal lines will decrease as the wave frequency increases

The following Applet can be set for a triple slit, (on the set up menu pick triple slit):

http://www.falstad.com/ripple/index.html this may be simpler and easier to see than on the ripple tank

Safety

Beware water on the laboratory floor. Make sure you have a sponge and bucket handy to mop up spills immediately.

Place the power supply for the lamp on a bench, not on the floor by the tank

Technical notes

You need 2 large barriers and 6 small barriers

The hand stroboscope is a disc of hardboard or card with a simple pivot at its centre, so that the disc can be kept spinning by hand.

The disc has a finger hole, off-centre, to enable the user to keep it spinning. It has narrow slits on its face, near the rim. The slits are evenly spaced and 12 slits are best

This simple stroboscope enables students to 'freeze' repetitive motions – or to slow them down for closer study. For example, continuous ripples are easier to see by using a stroboscope, especially those ripples with higher frequencies. By viewing a vibrating object through the slits, students can calculate the frequency of a vibration.

The stroboscopes are less likely to judder while rotating if the bearing is not too tight and the handle is held loosely.

External references

This activity is taken from Salters Horners Advanced Physics, section DUTP, activity 17 and http://www.practicalphysics.org/