Exploring wave motion
Passing light through multiple apertures

Commentary
Now I'm going to carry out a diffraction experiment using hundreds of narrow apertures at the same time. This will give a much clearer pattern on the screen over there and enable you to take fairly accurate measurements from your TV screen. In order to do that I'll use a device called a diffraction grating that consists of hundreds of narrow lines spaced very close together and, in fact, this slide contains three separate diffraction gratings. The first one I'll be using has 300 lines per millimetre, that's like 300 apertures packed into every millimetre across it. So the spacing between the individual lines is one three-hundredth of a millimetre, or about 3.3 microns. So first of all I'll shine the red laser beam through the grating with 300 lines per millimetre. Instead of smoothly changing dark and bright regions, the diffraction pattern this time consists of a series of isolated spots on the screen. But the image is created by the same process of interference between light waves coming from different positions on the grating. These spots are referred to as diffraction orders and they come in pairs either side of the centre. The central spot is called the zero order, the two outside that are the first order, then come the second order, and so on. If I now swap the grating for one that has only 100 lines per millimetre, that's a spacing of one-hundredth of a millimetre, or 10 microns, the diffraction pattern becomes less spread out. So larger, more widely-spaced apertures give rise to less diffraction. And finally, using a grating with 600 lines per millimetre, a spacing of about 1.7 microns, you can see that the pattern becomes very spread out indeed. So just as you saw with the single apertures, narrower apertures give rise to more diffraction. Here are all three diffraction patters displayed together from the three different gratings. Now I'm going to illustrate how a different wavelength alters the diffraction pattern. I've put the original 300 lines per millimetre grating back but now I'm going to use the green laser beam. So let's look at the diffraction pattern now. Here are the red and green diffraction patterns displayed together for comparison. As you've seen before, a shorter wavelength gives rise to less spread in the diffraction pattern.