3.4.1 Wave interference

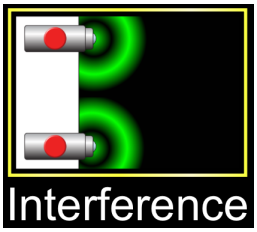
videos

When waves of the same frequency and similar amplitude overlap, they combine ('superpose') to produce areas of constructive interference and destructive interference. Constructive interference occurs when waves from different sources arrive at a certain point with zero phase difference. This means that peaks arrive together leading to 'super peaks' and troughs arrive together producing 'super troughs'. Destructive interference occurs when waves from different sources arrive in antiphase (180° phase difference). This means that a peak from one source will cancel a trough from another source and vice versa.

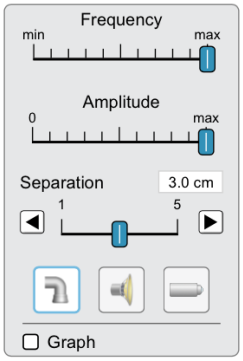
PhET SIM

Open the following simulation:

https://goo.gl/KS4Nxa

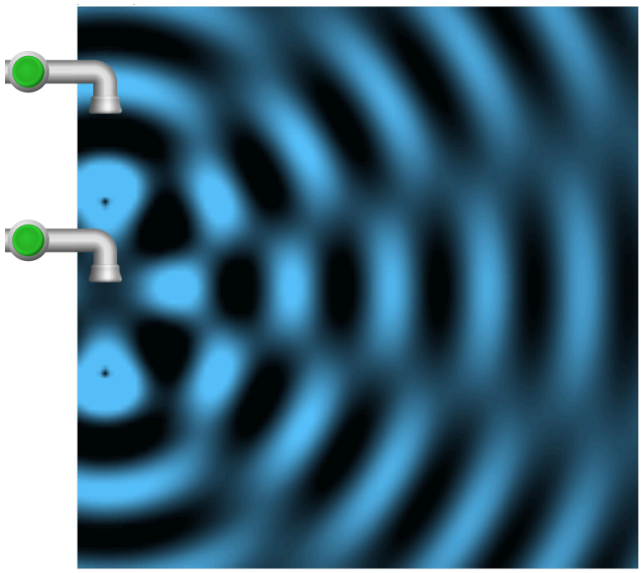
Choose the 

interference simulation.



Select the highest frequency using the slider.

You should see the pattern, below:



We can see areas of constructive interference and destructive interference.

(1) Draw red lines to show areas of constructive interference.

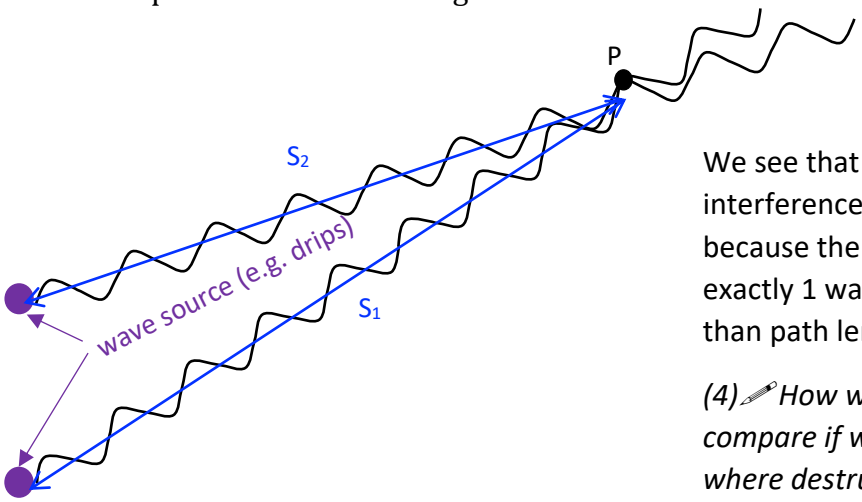
(2) Draw blue lines to show areas of destructive interference.

Try changing the drip separation.

(3) What happens to the separation of the areas of constructive and destructive interference as the drip separation is increased?

Path difference

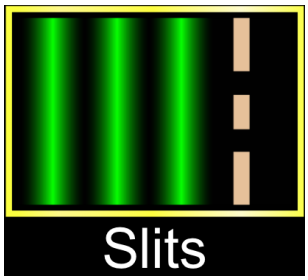
Constructive interference occurs at a point, if the path difference between sources of waves is multiples of whole wavelengths.



We see that constructive interference occurs at P, because the path length S_1 is exactly 1 wavelength longer than path length S_2.

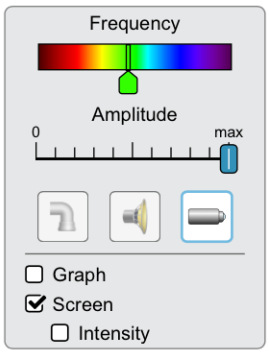
(4) How would path length compare if we had a point where destructive interference was happening?

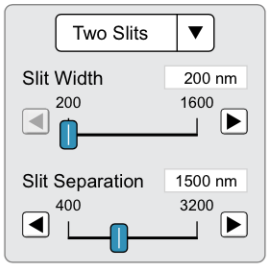
Light Interference

Now choose the slits 

simulation.

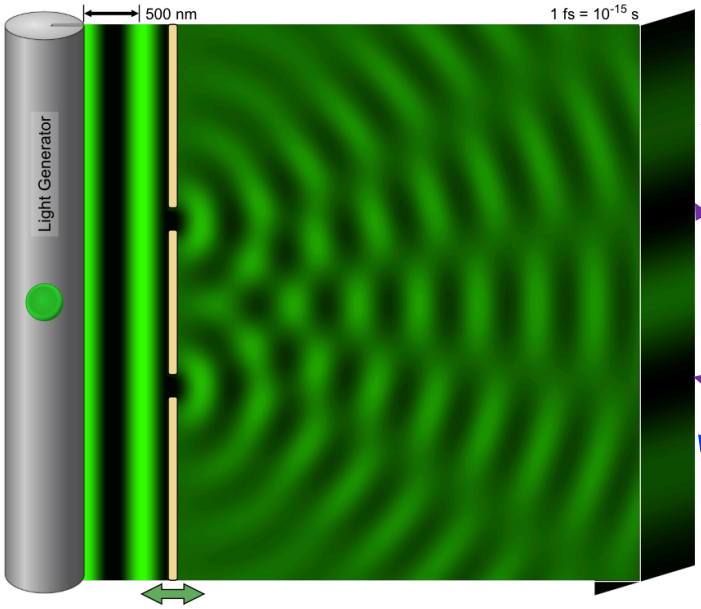
And carefully select the the settings shown to the right:





Move the barrier (with slits) to the left hand side.

You should see something like the following:



Areas of high intensity where waves have combined constructively. Called 'bright fringes'.

Areas of low intensity where waves have combined destructively. Called 'dark fringes'.

The gaps in the barrier act as sources of waves (similar to the drips). They spread out and interfere, producing light and dark bands (fringes) on the screen.

(4) Now change the slider to select red light. How does this affect the the separation of bright fringes on the screen?

(5) What is the rough wavelength of red light (see value in scale at the top left of the screen)?

(6) In terms of magnitude, how does the slit width compare to the wavelength of the light?