Wave Nature

Name: Key

Diffraction PhET Lab

Wave Interference

Introduction: When waves momentarily overlap, they temporarily add their amplitudes without affecting the original waves. This **interference** can be seen when two wave sources are used and their overlaps viewed. You will view this phenomenon in parts I and II of this lab. When a wave strikes a barrier, some of the energy will bend around the barrier and spread out. This is known as **diffraction**. In part three of the lab, you will view the results of splitting a single wave source with a narrow slit, and then observe as the new waves created at the slit interfere. The interference pattern that results is symmetrical. The bands of constructive interference are referred to as *maxima* (single=*maximum*).

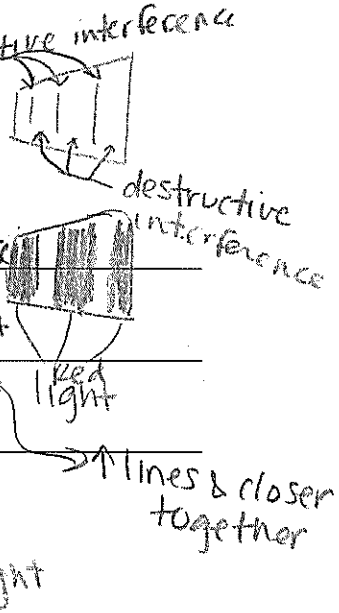
Procedure: *Go to https://connexions.github.io/simulations/wave-interference/*

Part I: Water Waves Analogy *take some time to familiarize yourself with the simulation's controls*

- Observe the water waves created in the faucet analogy. The darker areas are areas of higher amplitude.
- Adjust frequency and amplitude and observe the characteristics of the waves.
- Comment on the waves as amplitude is changed: ↓A = sm drop so smaller wave, ↑A = lg drop so larger wave
- Comment on the waves as frequency is changed: ↑f = ↑waves/time (faster), ↓f = ↓waves/time (slower)
- Now add a second drip to the simulation. Observe the interference of the two water waves.
- Comment on the interference of the two waves: in some areas they seem larger & some areas they seem smaller

Part II: Light Wave Interference *Please note the waves take some time to settle out and show good graphs-be patient*

- Change the simulation to show extremely-slowed light emission from the single-light source. Light
- Observe the wavelength of red light (longer λ) and then move the wavelength slider to cyan or blue light (shorter λ).
- Comment on the actual wavelength of blue light versus red light. blue < red (λ)
- Add the screen to show how the light would look if viewed on a screen Show Screen
- Add a second light source and view the interfering waves and the pattern they create on the screen.
- Showing the *Intensity Graph* quantifies the energy that is incident upon the screen.



What effect does amplitude have on the maxima separation in the interference pattern?

↑amp ⇒ the interference pattern just seems ↑intense

What effect does source spacing have on the maxima separation in the interference pattern? ↓lines & spread out

when they are closer together there is less interference when they are farther apart there is more interference

What effect does wavelength have on the maxima separation in the interference pattern?

(↑f) ↓λ ⇒ more stripes, more interference

Part III: Light Wave Diffraction

- Reset the light waves simulation and show the screen and graph.
- Add a 2-slit barrier to the simulation and allow the graphs to be formed.
- Observe the interference pattern created when the characteristics of the simulation are adjusted.
- You may have to adjust amplitude when other elements of the simulation are changed to observe the graph.

What effect does a larger amplitude have on the maxima separation in the interference pattern?

↑ amp doesn't seem to impact separation - just makes them brighter

What effect does a shorter wavelength have on the maxima separation in the interference pattern?

↓λ (↑f) = ↑ # of lines & closer together

What effect does a larger barrier-to-screen distance have on the maxima separation in the interference pattern?

lg barrier-screen dist = bands are more spread out

What effect does a smaller slit width have on the maxima separation in the interference pattern?

Sm. slits = ↑ diffraction & ↑ # lines & closer together

What effect does a smaller slit separation have on the maxima separation in the interference pattern?

smaller slit separation shows fewer lines & further apart

Conclusion Questions and Calculations: *You may check your approximate answers in the simulation*

1. Why would a helicopter passing over or near a TV antenna cause a garbled or unusable TV signal?

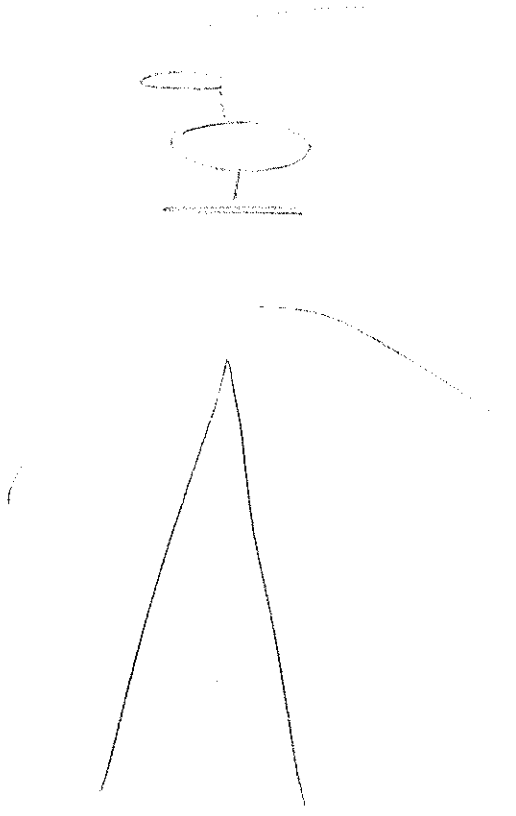
the helicopter would act as a barrier that could cause the waves to diffract or reflect

2. The simulation uses monochromatic light. If white light was used instead, what would be seen on the screen?

a separation of color - perhaps rainbow colors

3. As wavelength of the incident light increases (blue→red) the maxima separation *increases*/ *decreases*.

(Shorter) (longer)



blue

(↓λ) ↑f = ↑ lines & closer together

red

(↑λ) ↓f = ↓ lines & farther apart