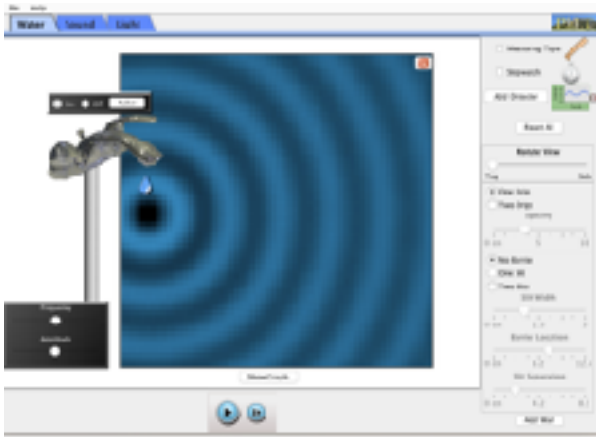
Wave Interference & Fringe Patterns

In this activity students will be exploring super positioning of water sound and light using the “Wave Interference” PhET simulation.

Open the simulation by clicking on the link:

https://phet.colorado.edu/en/simulation/legacy/wave-interference

Take a look at the explanatory video via YouTube:
https://youtu.be/DjUaUNC33Bc



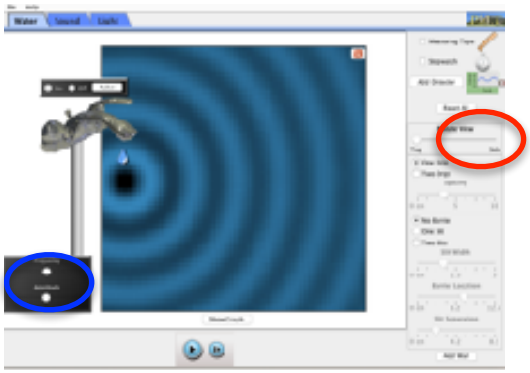
Learning Objectives

By the end of these activities it is hoped that students will have an acquired the following skills:

- Following explicit instructions to gain acquired knowledge
- Addition of Two drips to identify the formation of antinodes and nodes.
- Be able to explain super positioning using collected data.
- Investigating fringe patterns.

Author: Simon Lees 2017

Activity: Formation of Antinodes and Nodes



- Click on the two drop system clicking on the button shown in the red circle
- Place the drops 5cm apart by clicking in the same area.
- Set the frequency to 25% this is shown by the blue arrow. Increase the frequency through 50% and 75%. Let them run for each and observe the patterns.
- **What do you notice happens?**

- **Increase the amplitude. What happens?**

- Set the frequency to 50% run the program and pause after a few seconds. Take a screenshot of the picture and paste it below in the space provided.

Screenshot of 50% frequency interference pattern

- **Label the antinodes and the Nodes alongside the diagram above.**
- **What is an antinode?**

- **What is a node?**

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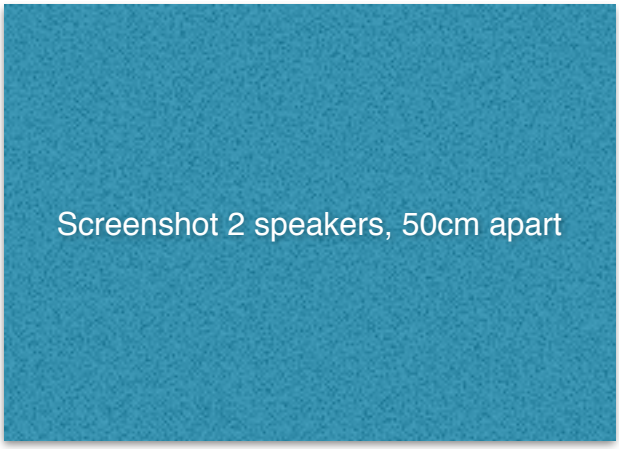
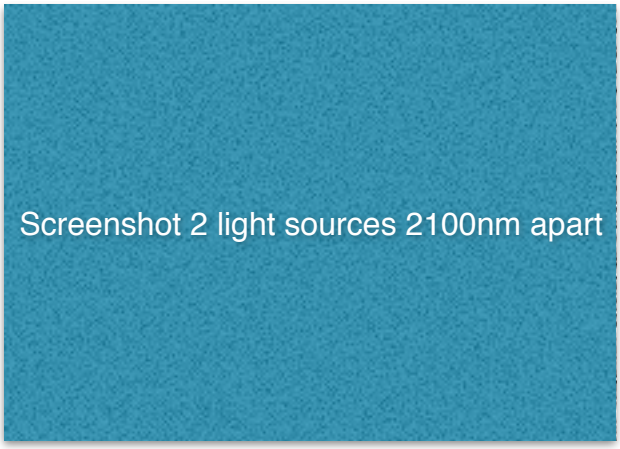
- Now look at the sound and the light pages by toggling the tabs on the top left of the page.
- Take screenshots of 2 speakers; 50cm apart & 2 light sources at 50% frequency; 2100nm apart both at and place them below:





- **What do you notice about these screenshot patterns when compared to the water wave interference pattern and what does this prove?**

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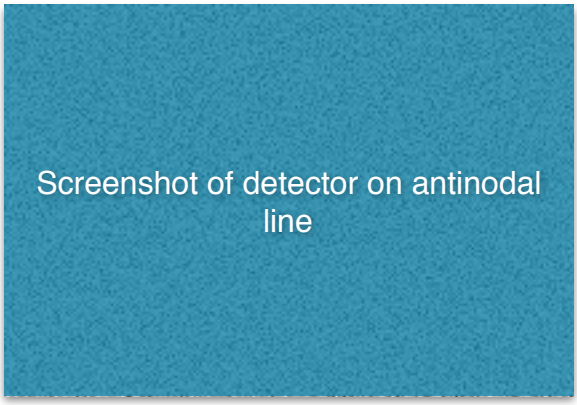
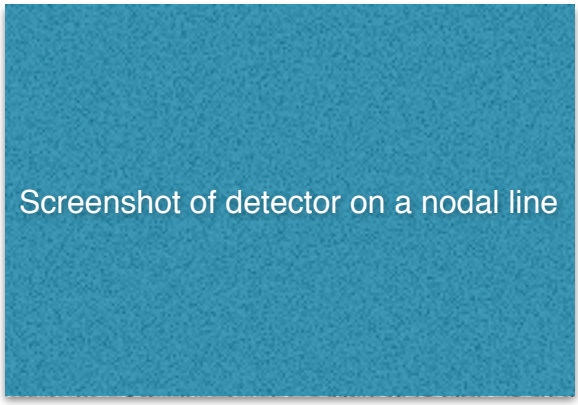
Activity B: Explaining superpositioning using data

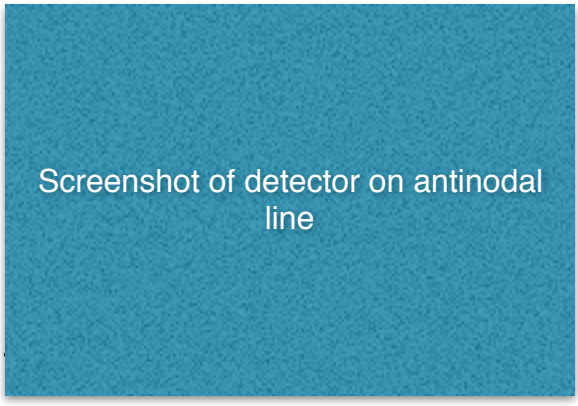
- Switch onto two drips 5cm apart and frequency at 50% and chose and an appropriate amplitude.
- Select the detector and drag the cross hairs to the centre of the middle **antinode** allow the graph to form and take a screenshot of the detector and pattern.
- Repeat this again but place the crosshairs on a **nodal** line. Take a screen shot and paste below.

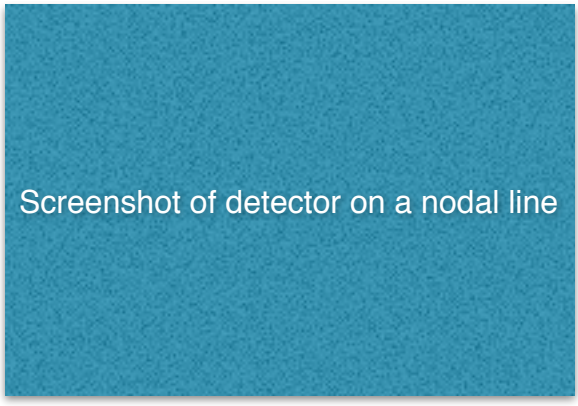




- **Use the data to explain how the antinodal and nodal lines form.**

- Now increase the amplitude and take screenshots for each line.



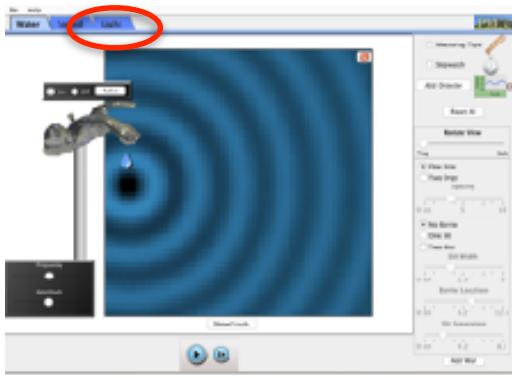


Compare and contrast the two sets of screenshots and explain why there is a difference.

Turn over to the next activity

Activity C: Investigating fringe patterns.

- Click on to the "**Light**" tab.
- With a single light source on red light click on the "**Show Screen**" on the right hand side and then the "**intensity graph**".
- Take screen shot of what you see and paste it in the space provided below.



- Now do exactly the same but add a second light source placed 2100nm apart.
- **Take a screen shot and paste it in the space provided.**

Screenshot of single light source with light intensity graph

Screenshot of double light source with light intensity graph

- **What are the differences and explain how the graph is formed.**

- Now click on the "**Show Graph**" at the bottom a hatched black line appears as does an "**Electric field**" graph below. The graph shows the waves moving a long this hatched line. Take a screenshot of what you see and paste below.
- Move the hatched line up or down so that a node crosses halfway a long the line and take a screenshot.

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Screenshot of central antinode graph

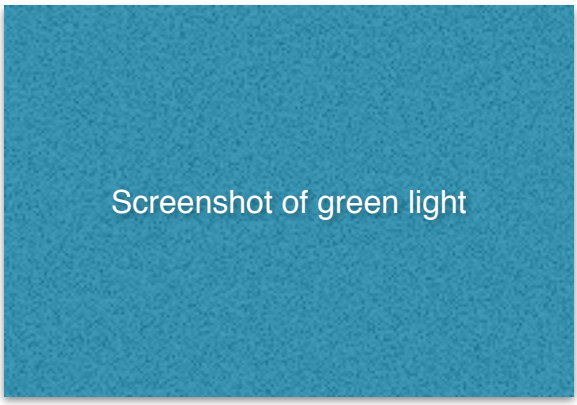
Screenshot of graph covering antinodal and nodal line

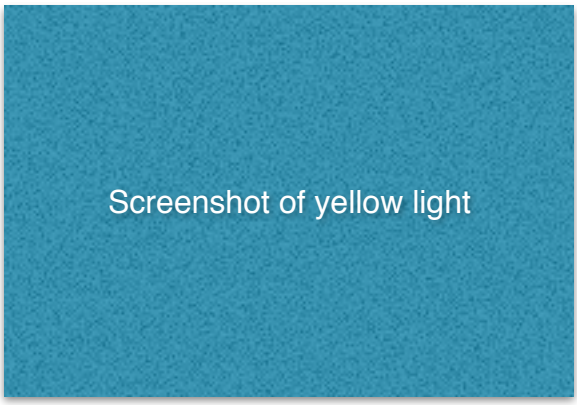
- **Compare your two screenshots and explain what you see in terms of superpositioning.**

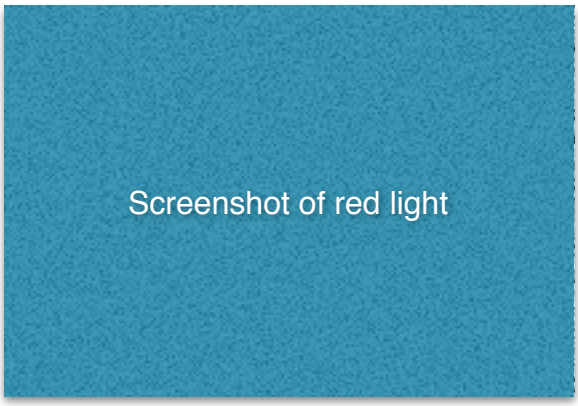
- Now turn the "**Screen chart**" and the "**Electric Field**" OFF and on the left hand side of the screen move the arrow down so purple light is showing through. Take a screen shot of the screen. Now move the arrow to blue; green; yellow and then red. Take a screenshot of each.

Screenshot of purple light

Screenshot of blue light







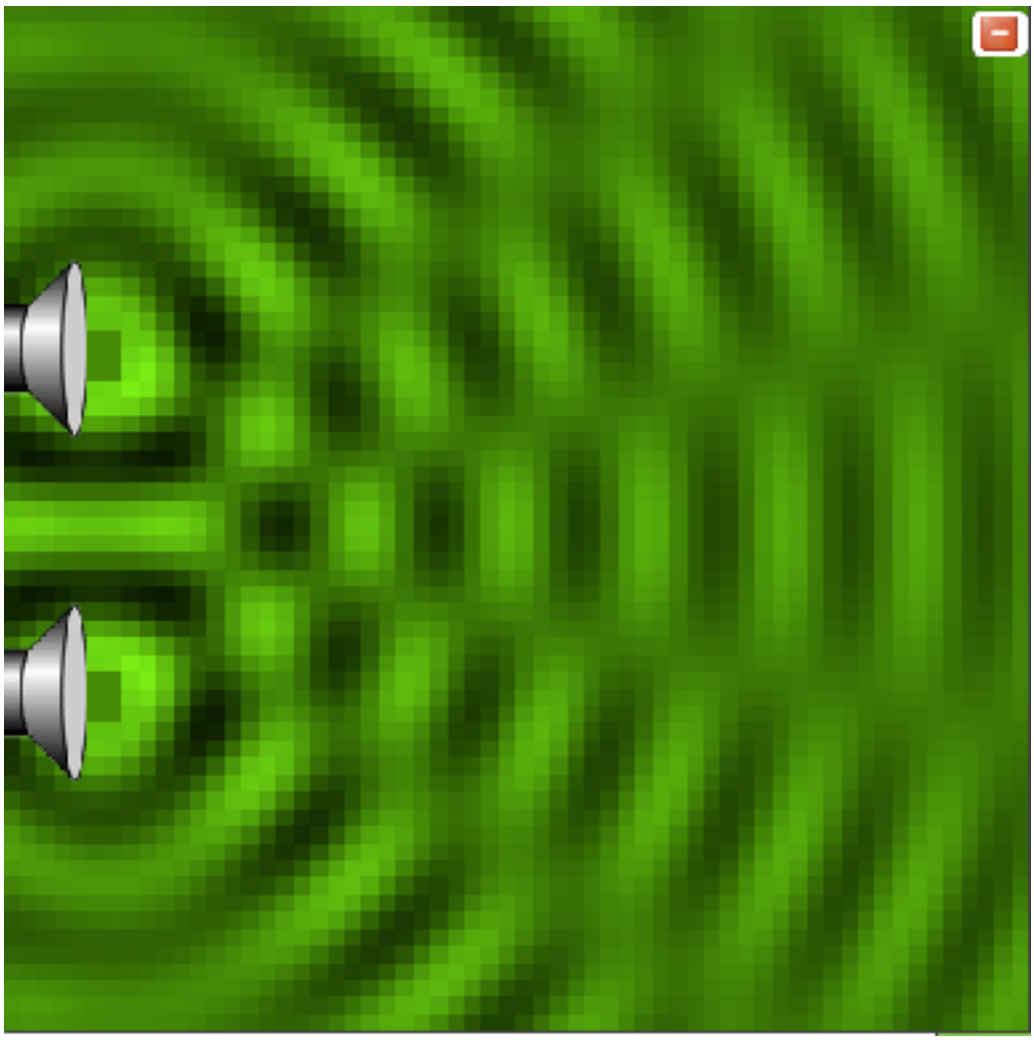
- **Compare the 5 screens and state what happens to the fringe patterns as the wavelength gets longer. Suggest a reason as to why you think this happens.**

SUMMARY:

- **Where a peak or crest meets a crest or a trough meets a trough what type of interference do we call this?**

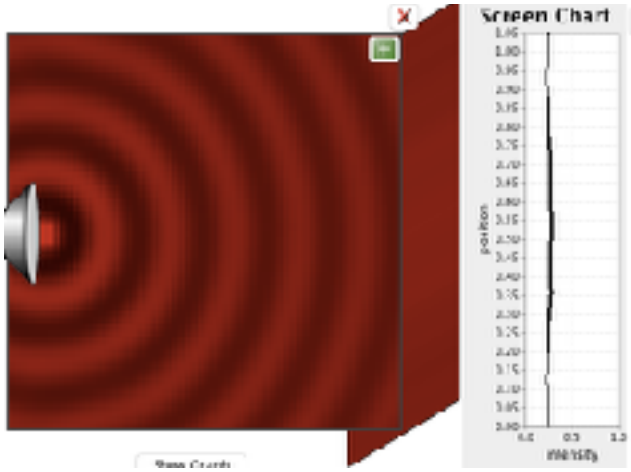
- **Where a peak and trough meets a trough and peak meets what type of interference do we call this?**

- **On the diagram below identify the areas mentioned in the last two questions and state what name they are given on the interference pattern.**

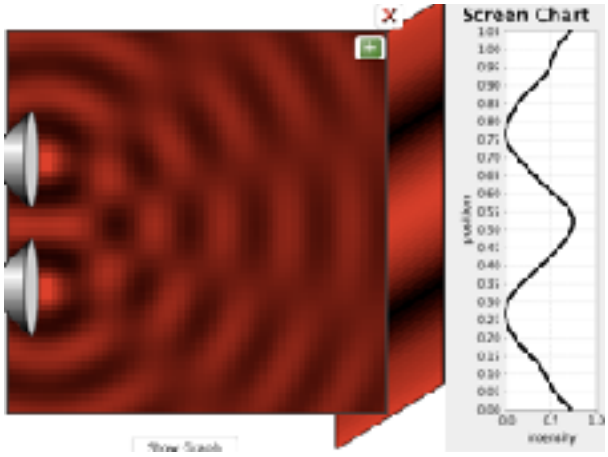


- **As you increase in wavelength what happens to the width of the fringe patterns?**

- **Why is it that when looking at a single light source and observing its intensity amplitude and then adding a second light source you go from a single line to a sinusoidal line of increased amplitude?**



Single Light Source



Double Light Source

- **If you increase the amplitude of a wave will it affect the fringe pattern. Explain your reasoning why and what it will affect if any?**