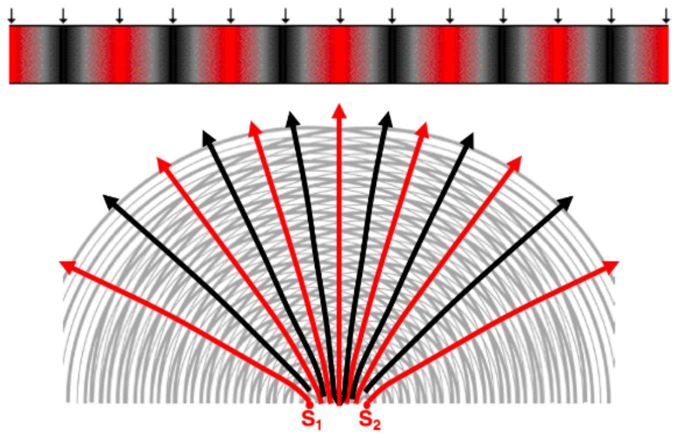
Young's Experiment
Lesson Notes

Learning Outcomes
- What is Young's Equation and how is it used?
- How do you perform Young's Experiment?

Light Interference Patterns
The collection of antinodal and nodal lines from a two-point source interference pattern can be projected onto a screen to display *maxima* (bright bands) and *minima* (dark bands).

Measurements can be made and the wavelength of light can be determined.

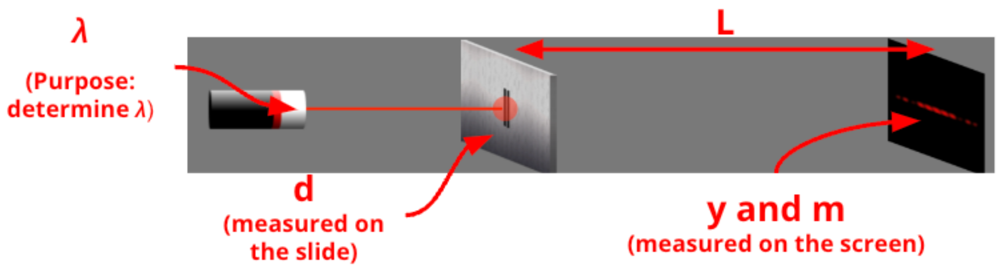


Young's Equation
Young's equation relates the wavelength of light to measurable quantities used of Young's experiment.

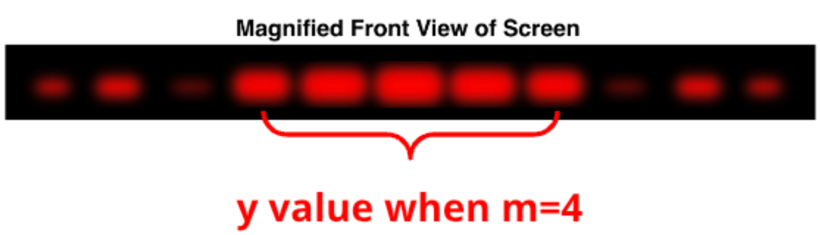
The experiment involves a double slit, a laser, and a screen. Measurements are made of …
- distance between the slits (**d**)
- distance from slits to the screen (**L**)
- distance between bright (or dark) bands (**y**)
- **m** (number associated with the selected band)

$$\lambda = \frac{y \cdot d}{m \cdot L}$$

Thinking About the Variables
The Young's Experiment set up looks like …



Bright bands on the screen are equally spaced.
The values of y and m go together. The **y/m ratio** is the distance between two adjacent bands.



Analyze the following problem statements and identify the values of y, d, m, and L.

Example 1:

Two slits separated by 0.250 mm produce an interference pattern in which the fifth dark band is located 12.8 cm from the central antinode when the screen is placed a distance of 8.2 meters away. Identify y, d, m, and L.

y = ____________ d = ____________ m = ________ L = ______________

Example 2:

Two sources separated by 0.500 mm produce an interference pattern 525 cm away. The fifth and the second antinodal line on the same side of the pattern are separated by 98 mm. Identify y, d, m, and L.

y = ____________ d = ____________ m = ________ L = ______________

Example 3:

The fifth antinodal and the second nodal line on opposite sides of an interference pattern are separated by 32.1 cm when the slits are 6.5 m from the screen. The slits are separated by 25.0 micrometers. Identify y, d, m, and L.

y = ____________ d = ____________ m = ________ L = ______________

Performing Young's Experiment Today

Slit separation distance (**y**) is often provided by manufacturer.

Slit-to-screen distance (**L**) can be measured ⊥ to the screen using a measuring tape. Insure tape is horizontal.

To reduce the effect of error, select two bright bands a maximum distance apart. Measure **y** and determine the number of *spacings*. The number of spacings is **m**.

Sample Data and Calculations

Purpose: determine the wavelength of red laser light in nanometers.

Data:

d=0.125 mm	➡	d=0.000125 m
y=48.2 cm	➡	y=0.482 m
m=8		m=8
L=11.62 m		L=11.62 m

The Equation

$$\lambda = \frac{y \cdot d}{m \cdot L}$$

Show the solution to …

$$\lambda = \frac{(0.482)\cdot(0.000125)}{8\cdot(11.62)} = 6.48\text{x}10^{-7}\text{ m} \rightarrow \boxed{648\text{ nm}}$$

Additional Example

A lab group uses a laser and a double-slit apparatus to project a two-point source light interference pattern onto a whiteboard located 15.00 meters away. The distance measured between the central bright band and the fourth bright band is 16.21 cm. The slits are separated by a distance of 0.250 mm. What would be the measured wavelength of light?