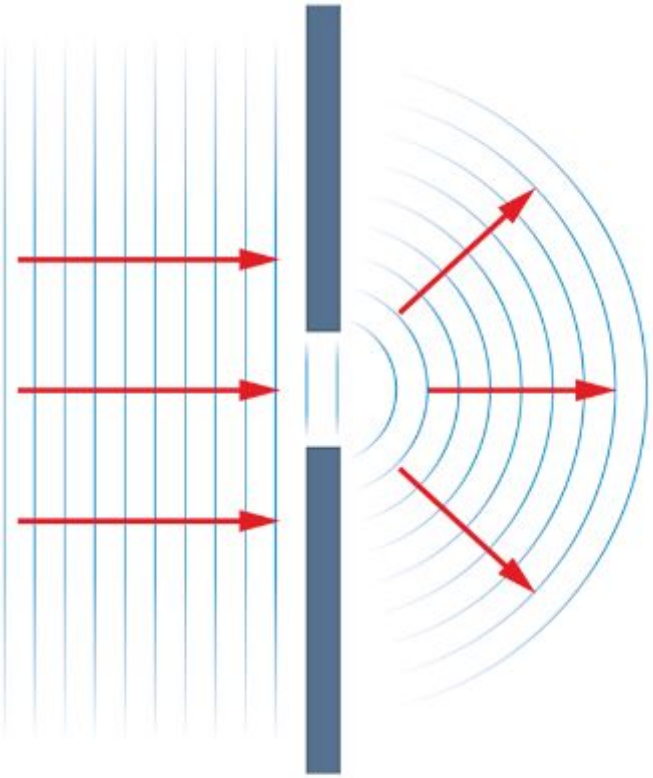
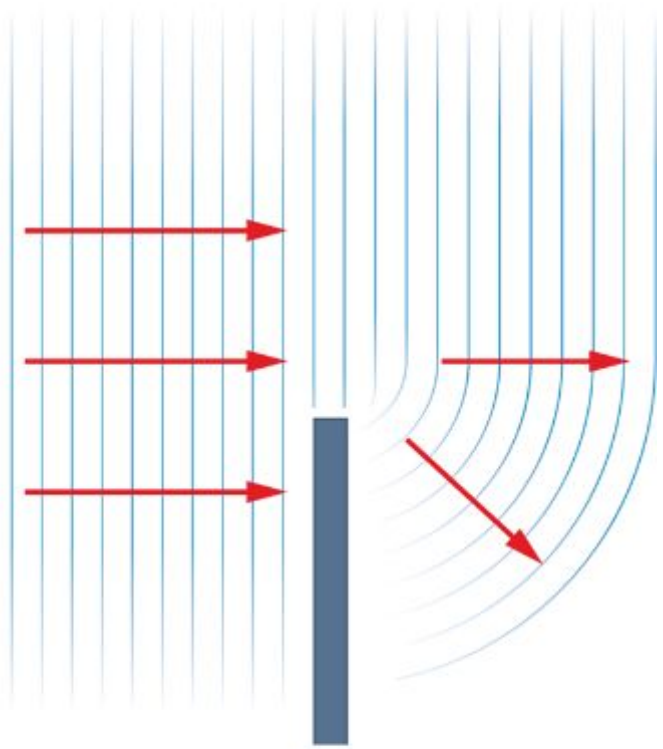
Diffraction

IB PHYSICS | WAVES - LIGHT

Diffraction



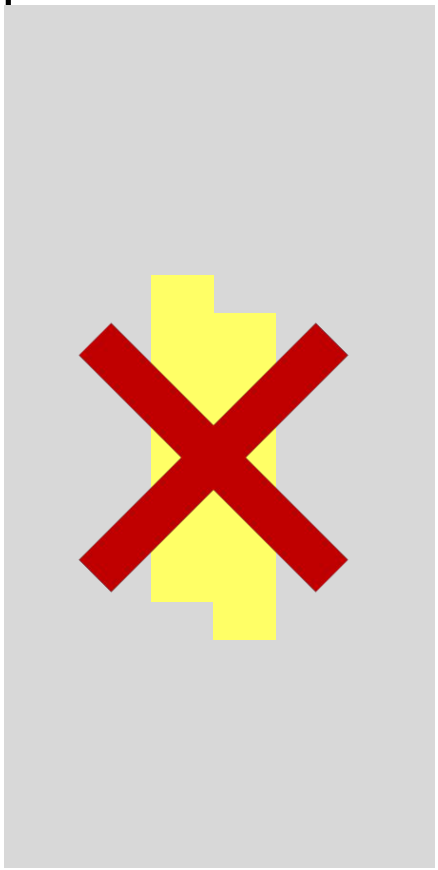
as the wave goes through
the gap it spreads out



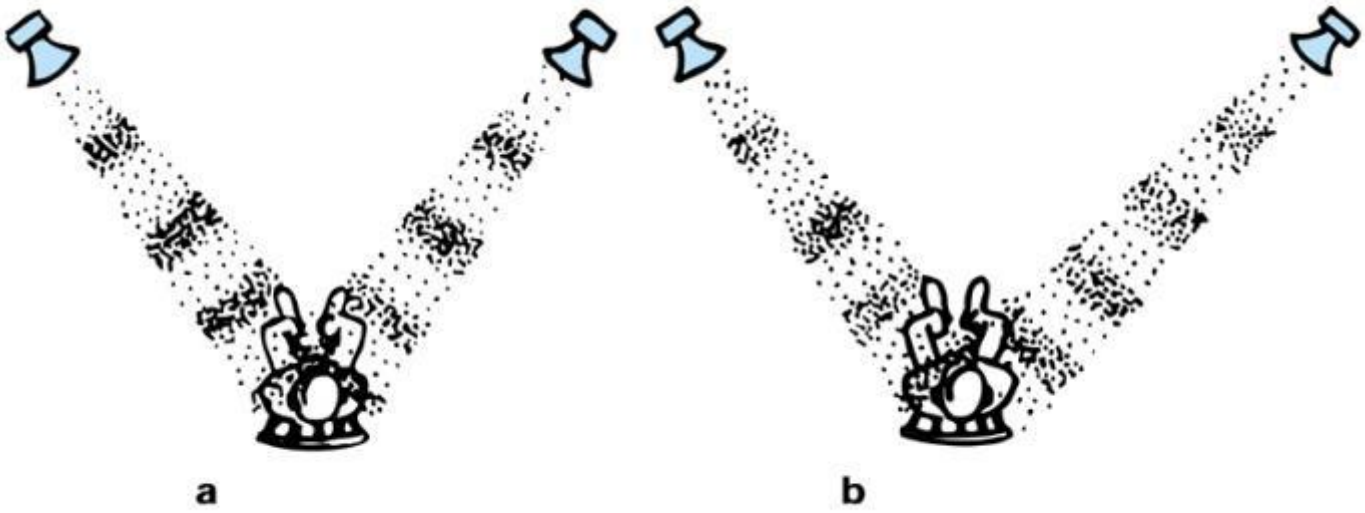
the same thing happens if
it goes around an obstacle

What would you expect?

You shine a light through two vertical slits in a barrier.
What is the resulting image on the screen behind?

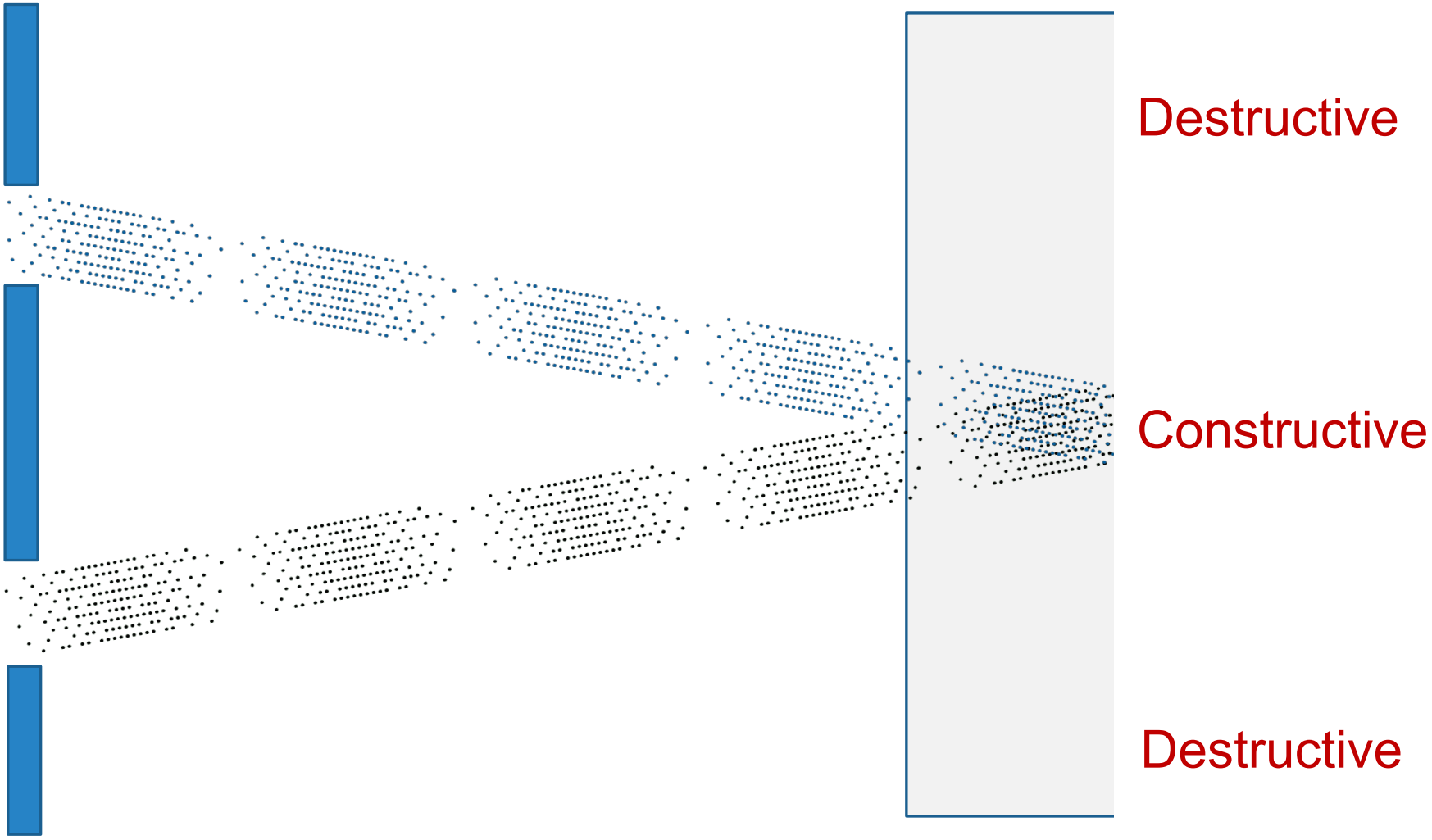


Remember Interference?

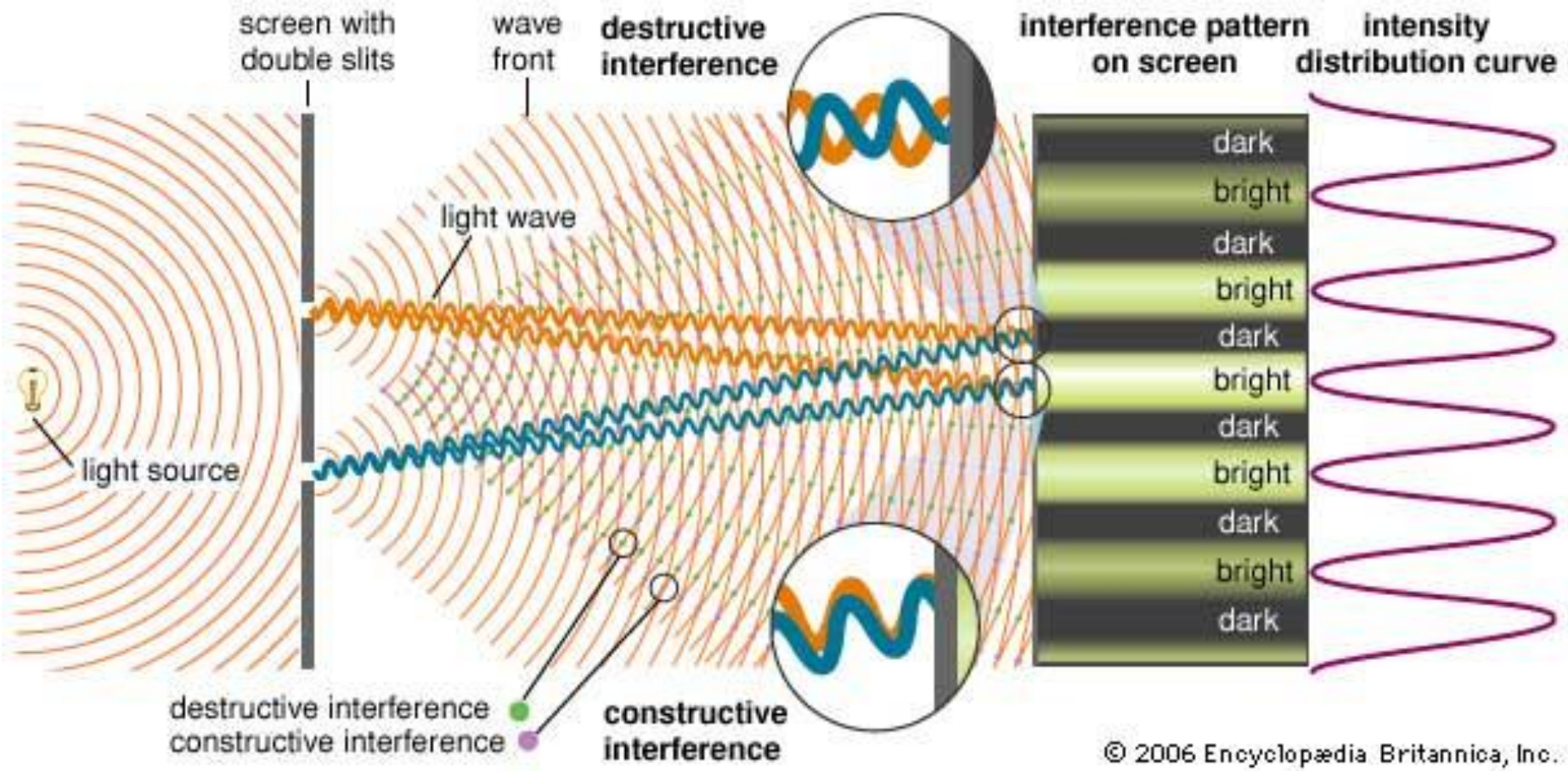


Constructive Destructive

Diffraction



Double Slit Experiment



Double Slit Experiment

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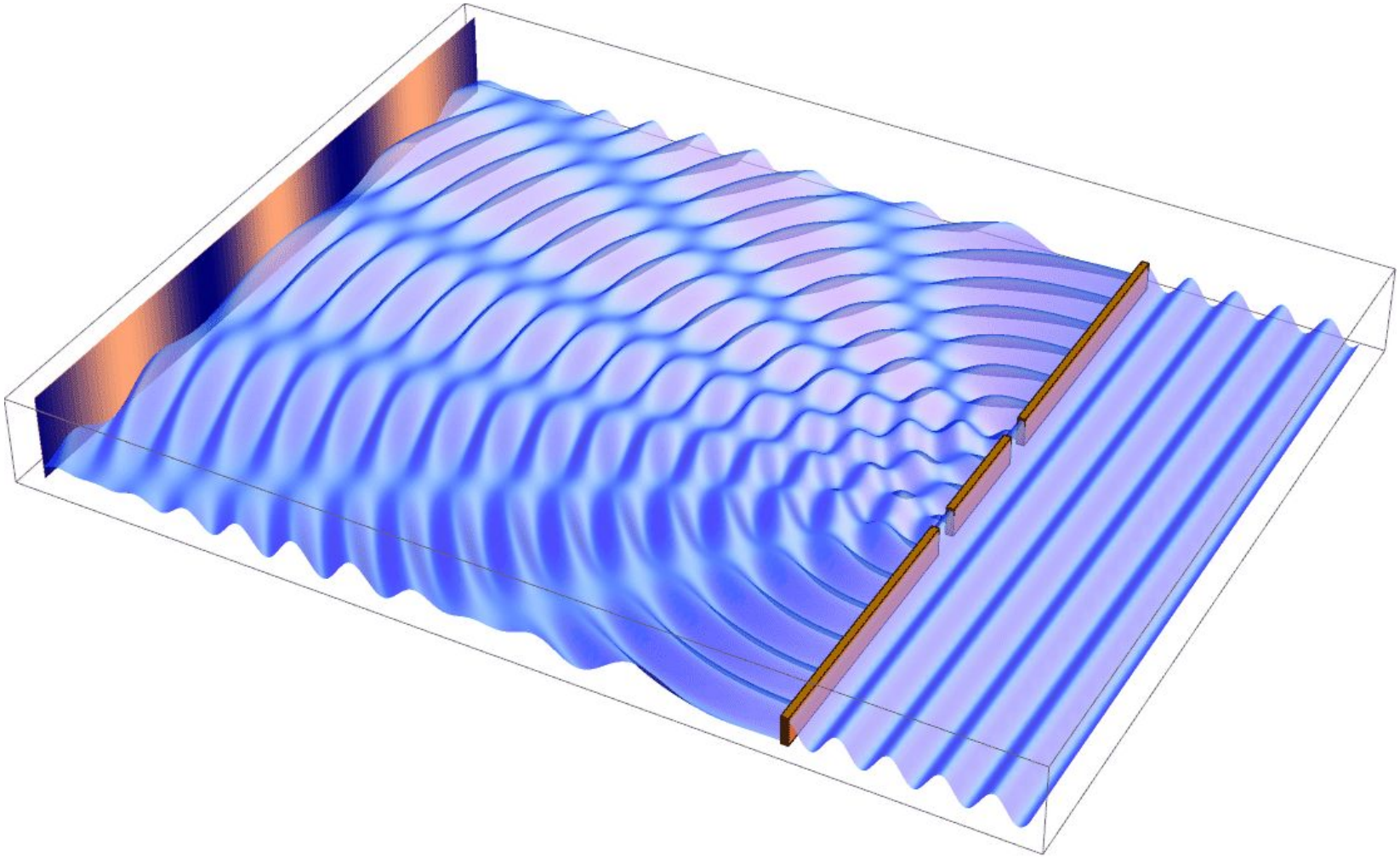
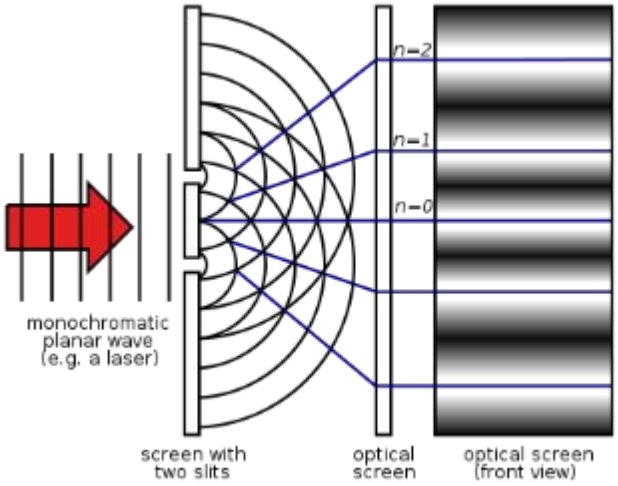
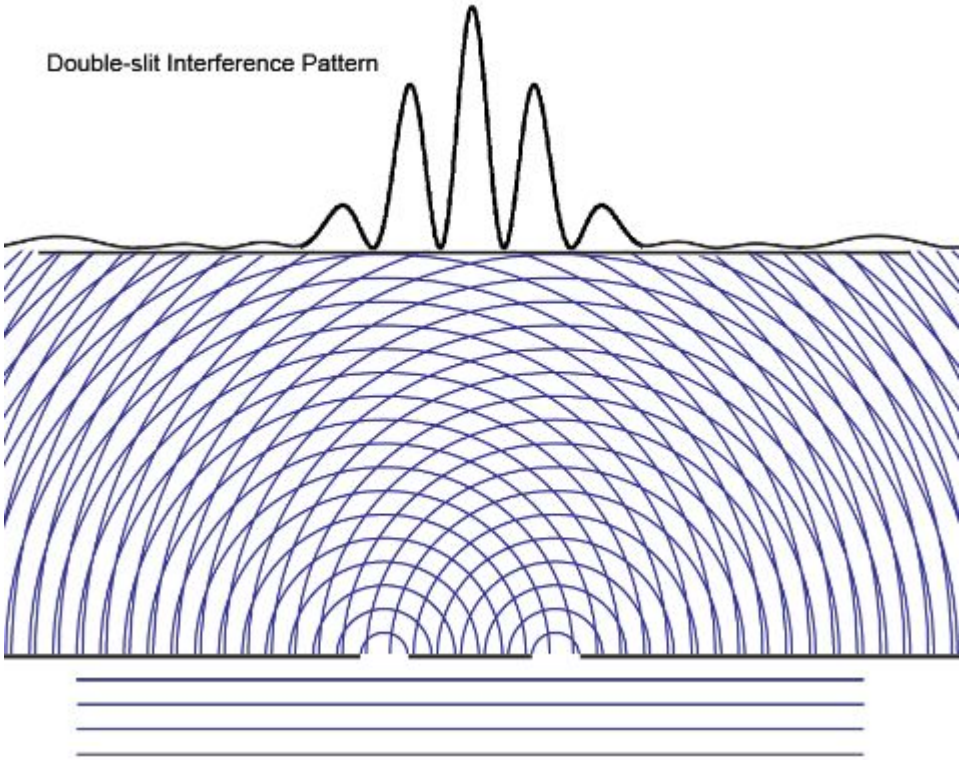


Double Slit Experiment

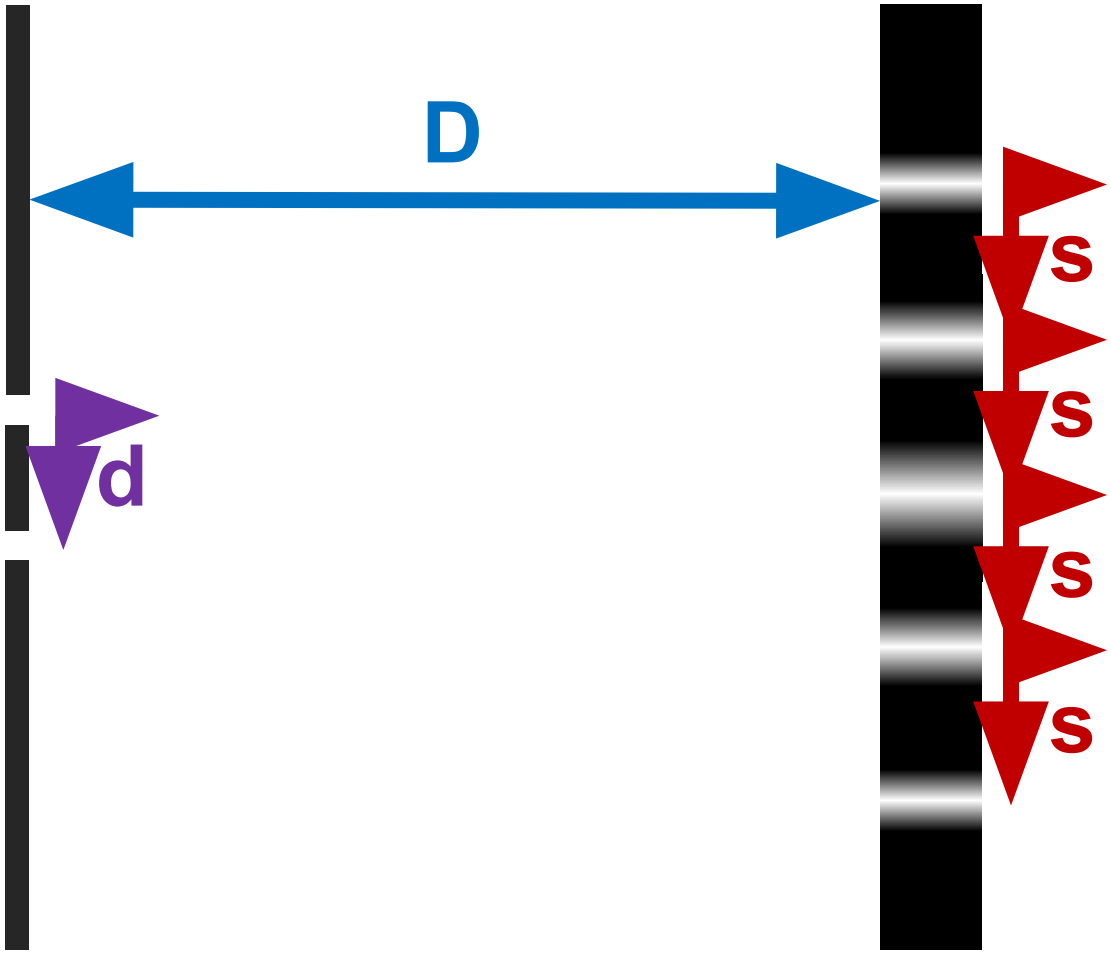




Double Slit Experiment

$$s = \frac{\lambda D}{d}$$

λ □ wavelength



IB Physics Data Booklet

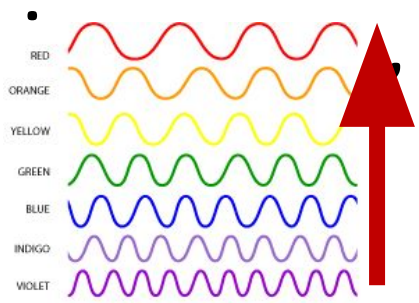
Sub-topic 4.1 – Oscillations	Sub-topic 4.4 – Wave behaviour
$T = \frac{1}{f}$	$\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$
Sub-topic 4.2 – Travelling waves	$s = \frac{\lambda D}{d}$
$c = f\lambda$	Constructive interference: path difference $= n\lambda$
Sub-topic 4.3 – Wave characteristics	Destructive interference: path difference $= (n + \frac{1}{2})\lambda$
$I \propto A^2$	
$I \propto x^{-2}$	
$I = I_0 cos^2\,\theta$	

milli	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}

Double Slit Experiment

$$s = \frac{\lambda D}{d}$$

As wavelength (λ)



s increases

As gap (d) increases,

s decreases

Try This

$$s = \frac{\lambda D}{d}$$

Blue laser light of wavelength 450 nm is shone on two slits that are 0.1 mm apart. How far apart are the fringes on a screen placed 5.0 m away?

$\lambda = 450 \text{ nm} = 450 \times 10^{-9} \text{ m}$

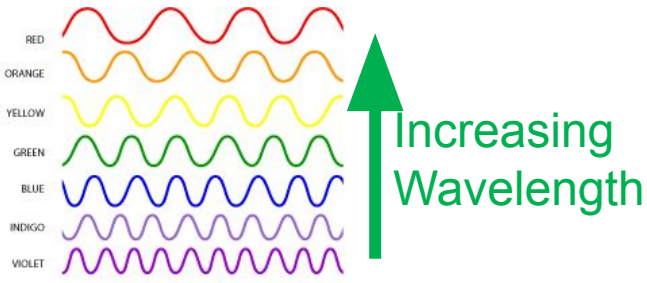
$d = 0.1 \text{ mm} = 0.1 \times 10^{-3} \text{ m}$

$D = 5 \text{ m}$

$$s = \frac{(450 \times 10^{-9})(5)}{(0.1 \times 10^{-3})}$$

$$s = \mathbf{0.02\ m}$$

Would red laser light have fringes closer together or farther apart?



As wavelength increases, fringes get farther apart

Lesson Takeaways

- ❑ I can describe how light bends around a boundary
- ❑ I can predict the resulting image from a double slit experiment
- ❑ I can calculate the spacing between bright spots for the double slit experiment
- ❑ I can conceptually relate band spacing with wavelength and gap distance