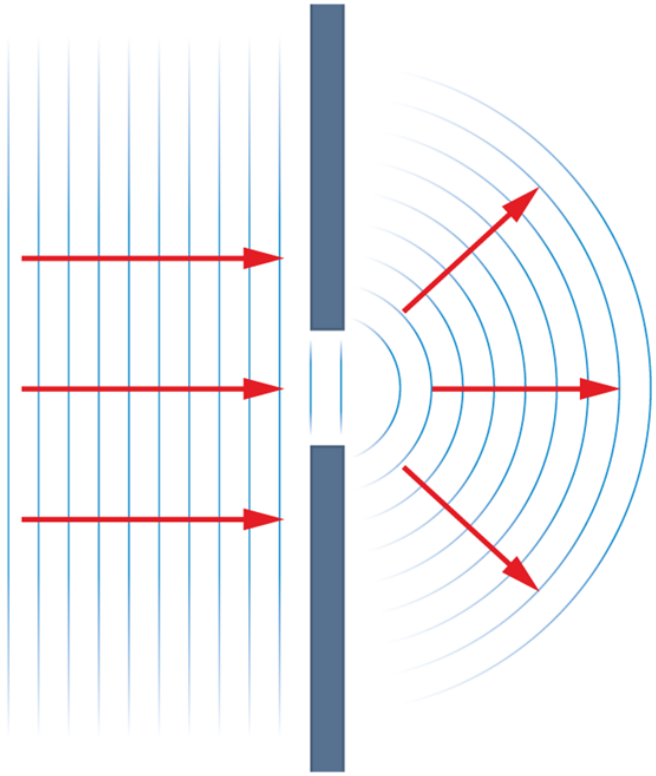
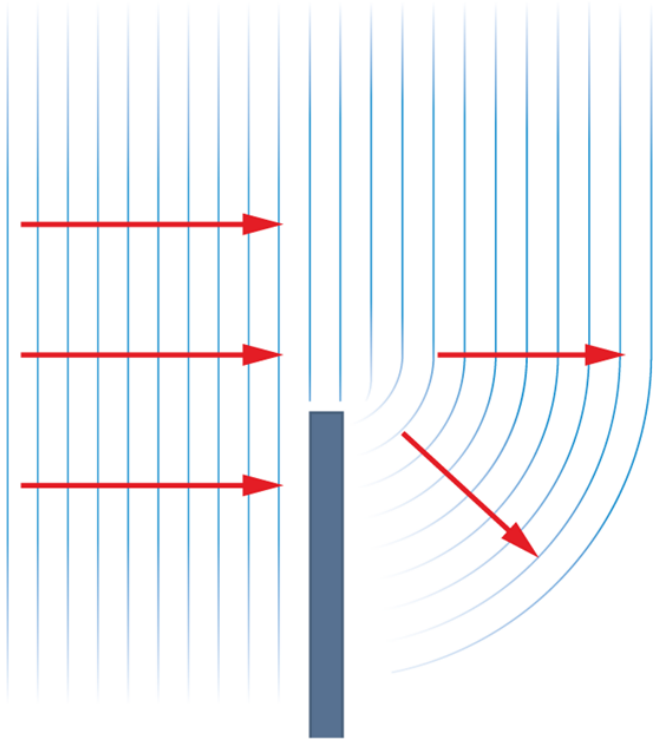
# Diffraction

IB PHYSICS | WAVES - LIGHT

# Diffraction



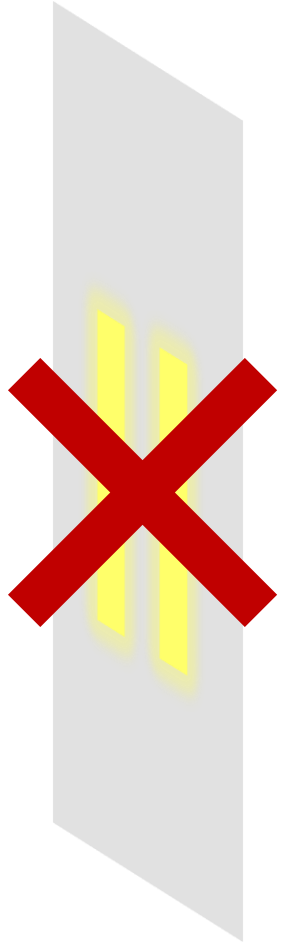
as the wave goes through
the gap it spreads out



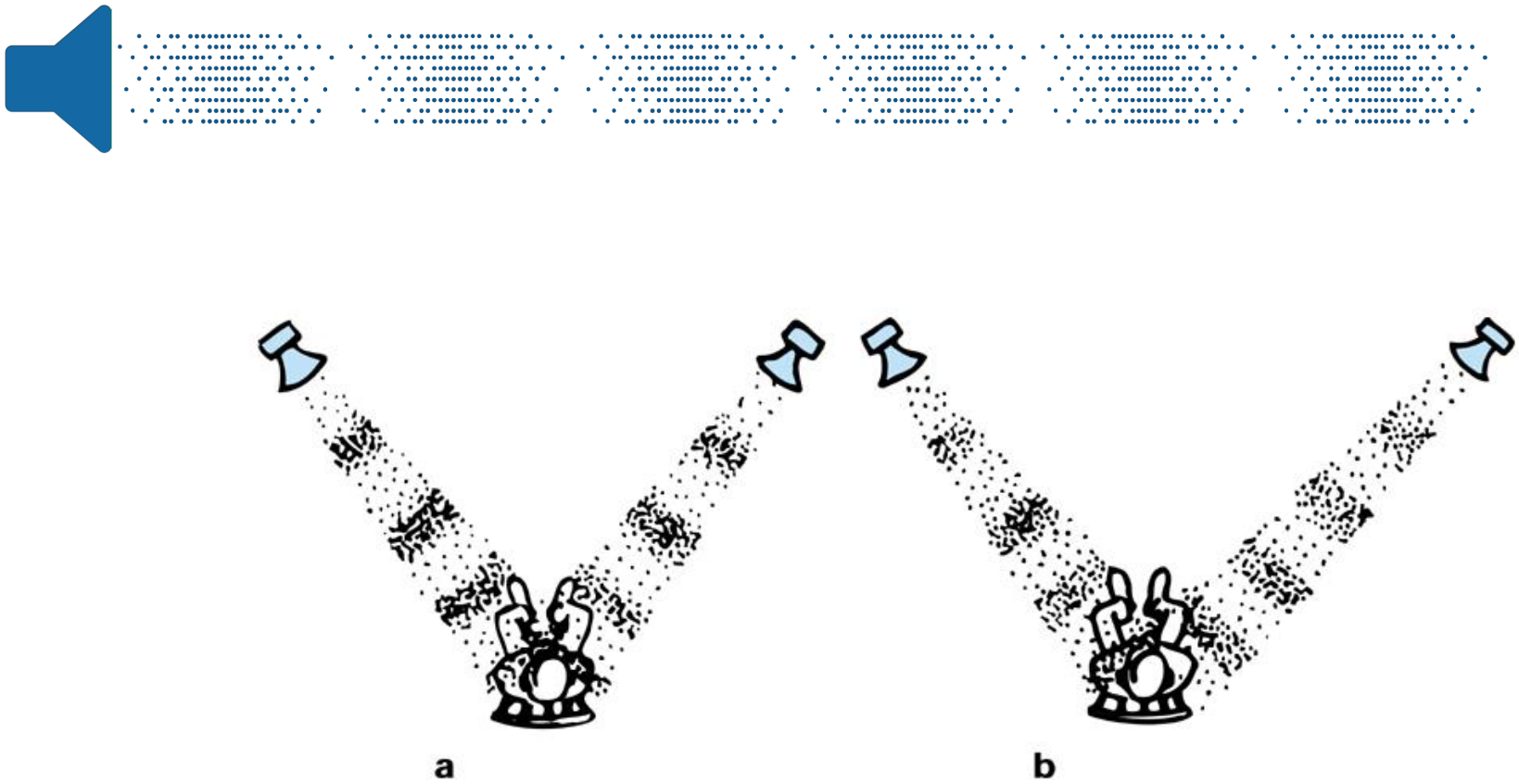
the same thing happens if
it goes around an obstacle

# What would you expect?

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



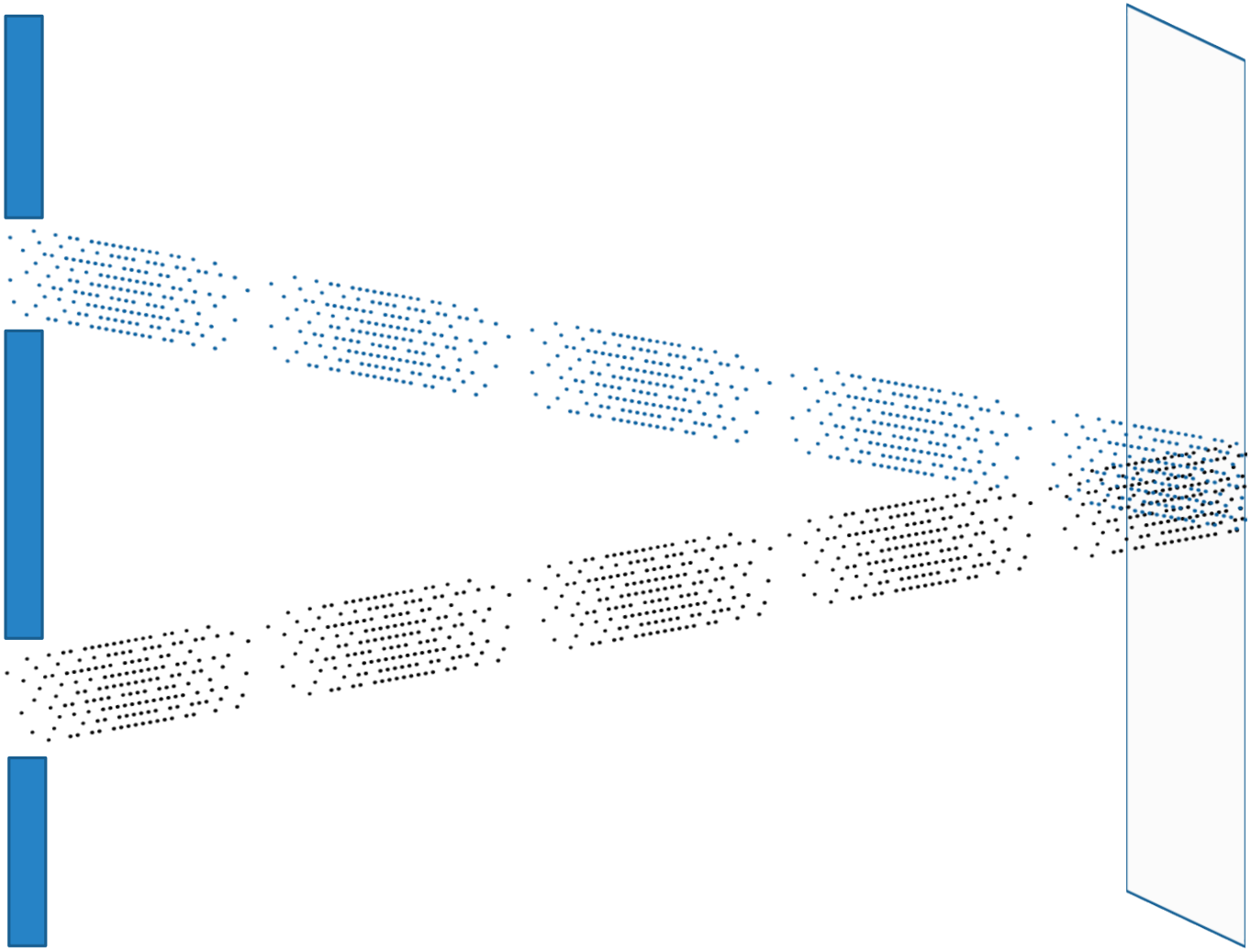
# Remember Interference?



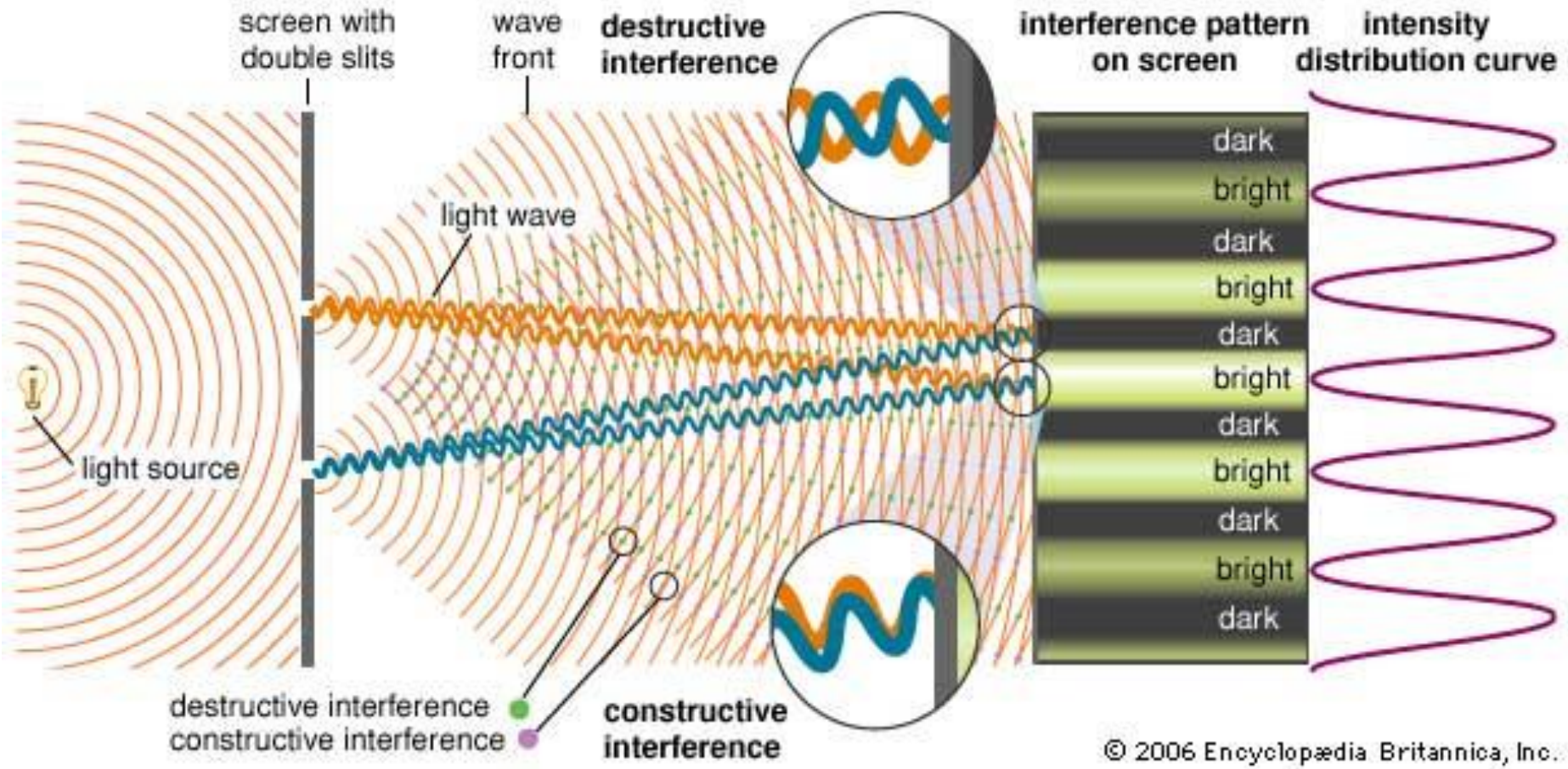

Constructive

Destructive

# Diffraction



# Double Slit Experiment



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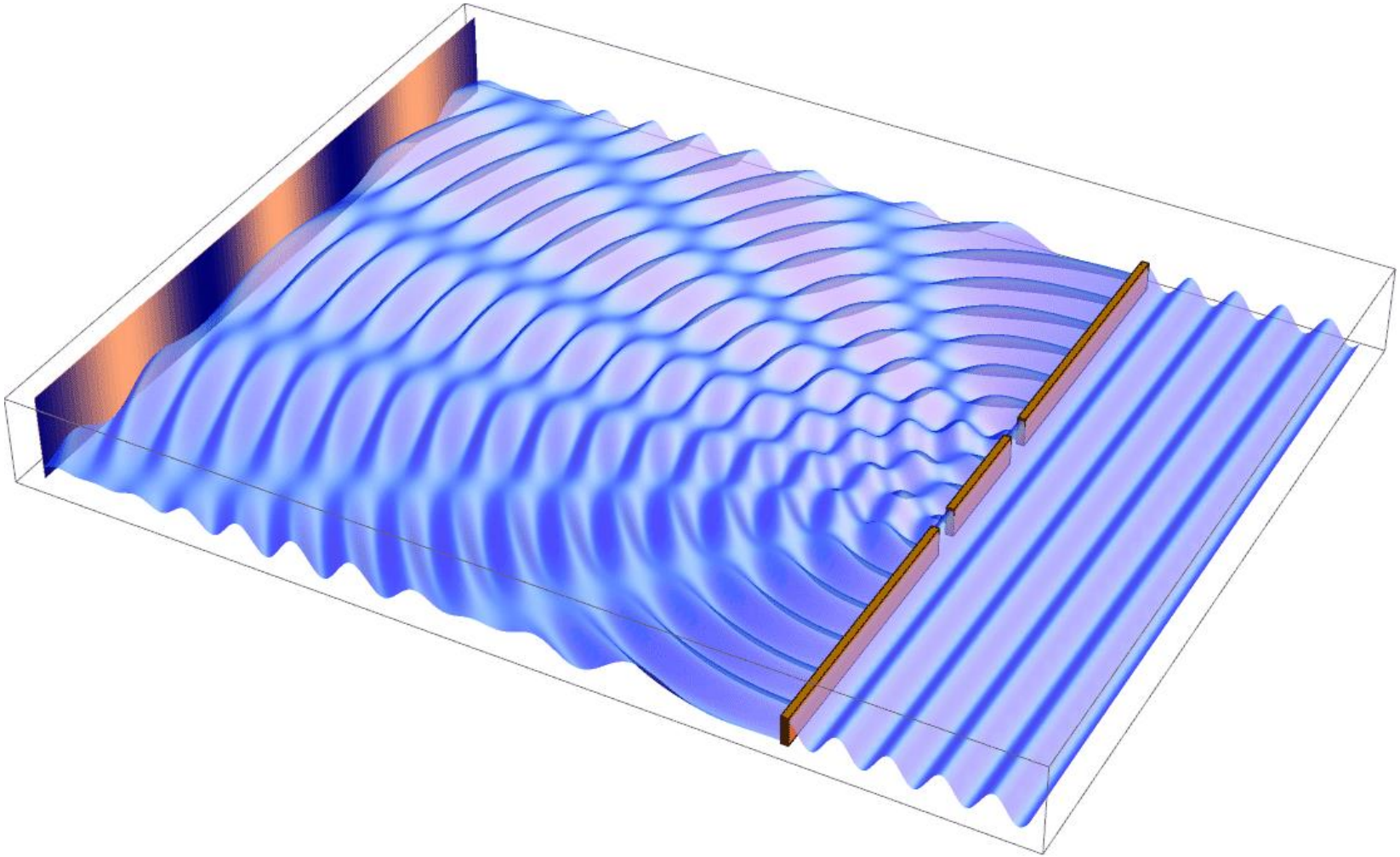
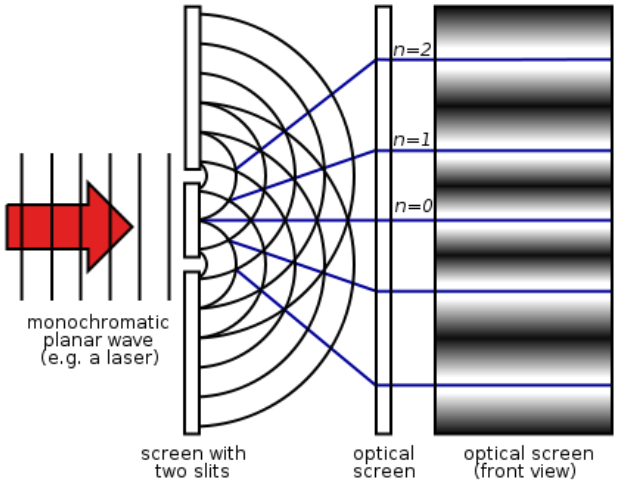
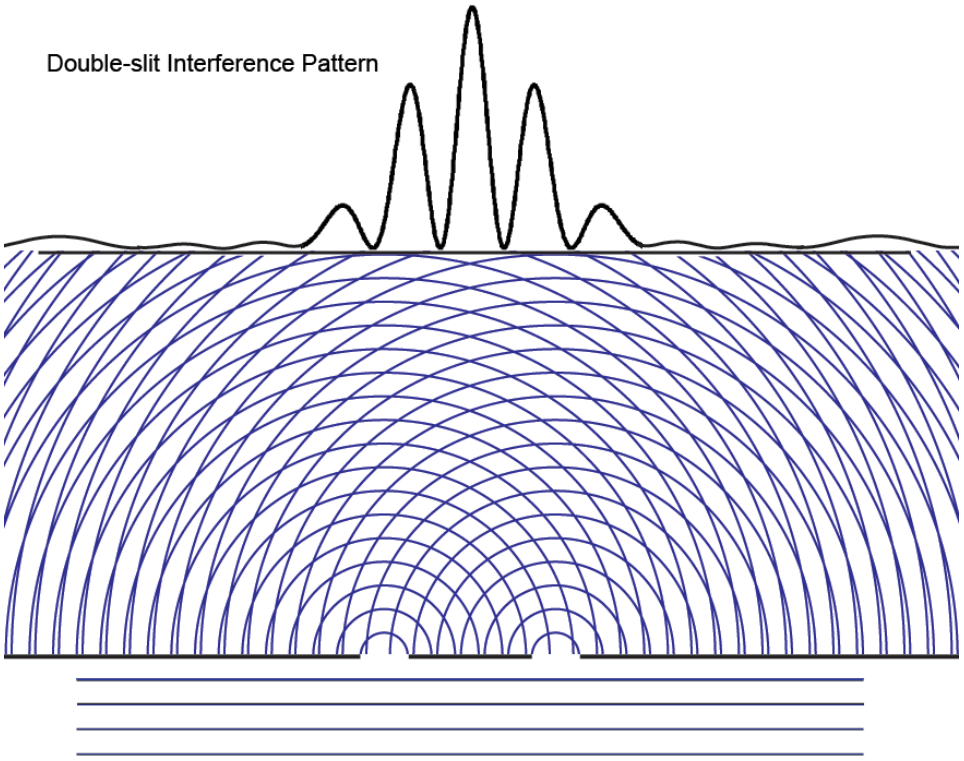


# Double Slit Experiment

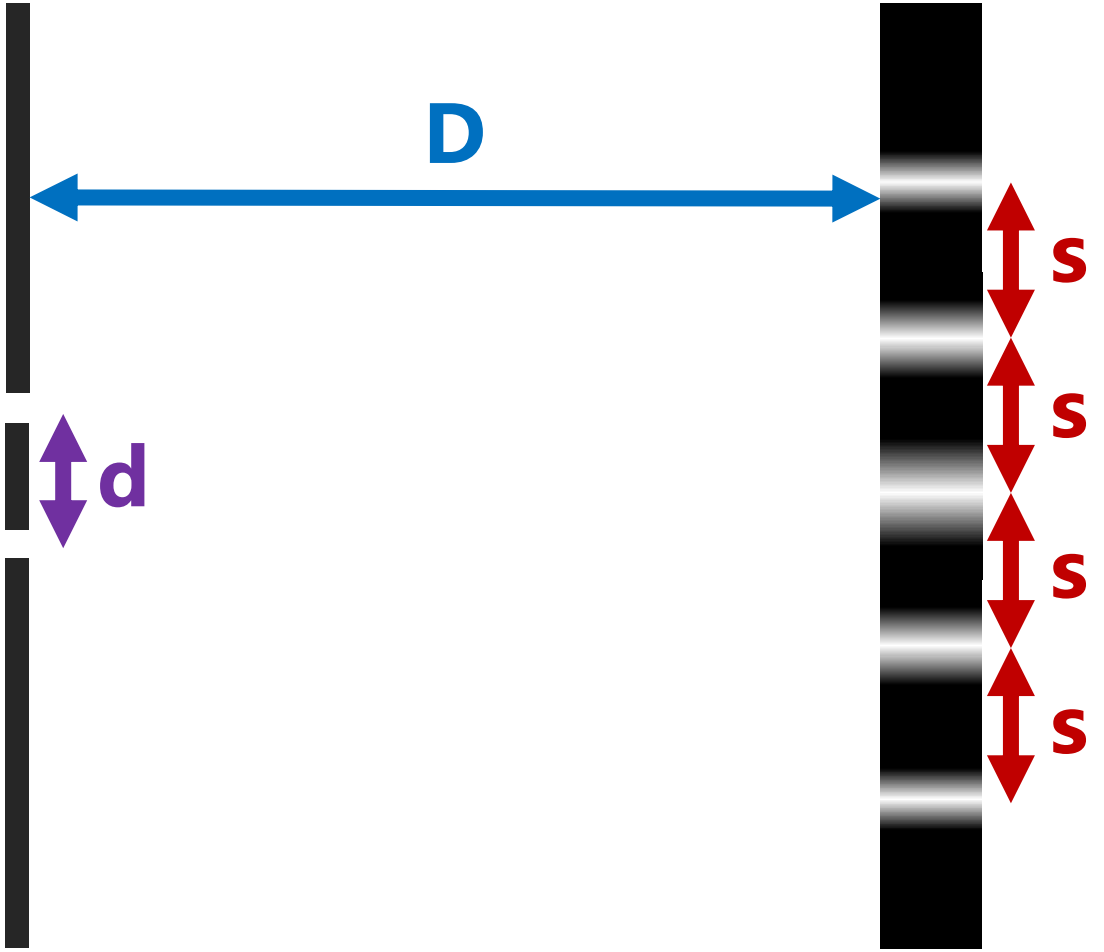


# Double Slit Experiment

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

**λ** → wavelength



# IB Physics Data Booklet

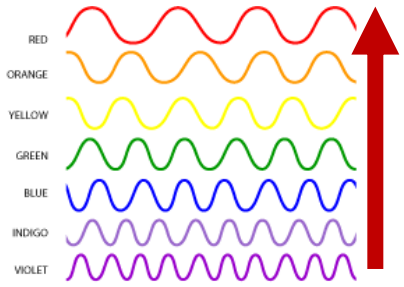
| Sub-topic 4.1 – Oscillations | Sub-topic 4.4 – Wave behaviour |
|---|---|
| $T = \frac{1}{f}$ | $\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$ |
| **Sub-topic 4.2 – Travelling waves** | $s = \frac{\lambda D}{d}$ |
| $c = f\lambda$ | Constructive interference: path difference $= n\lambda$ |
| **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) increases,




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 nm = 450 × $10^{-9}$ m

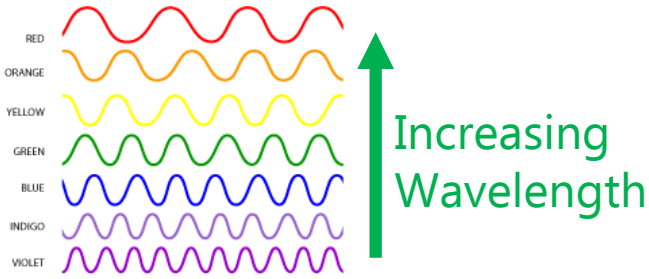
d = 0.1 mm = 0.1 × $10^{-3}$ m

D = 5 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