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| **Waves - Light** | IB Physics Content Guide |

# Big Ideas

* Light waves can be transformed through reflection, refraction, and diffraction
* Light travels at different speeds through different material

# Content Objectives

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| 1 – Light and the EM Spectrum |
| I can describe how the properties of electromagnetic waves change as frequency changes |  |  |  |
| I can identify and use the speed of light to solve wave problems with the wave equations |  |  |  |
| I can estimate the wavelength magnitude for the different EM waves |  |  |  |
| I can provide real world examples for each of the electromagnetic waves |  |  |  |

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| 2 – Reflection and Refraction |
| I can identify the angle of incidence and angle of reflection for a reflected wave ray |  |  |  |
| I can use the law of reflection to predict the way light bounces off of a plane mirror |  |  |  |
| I can relate the index of refraction of a material to the speed of light as it travels through |  |  |  |
| I can qualitatively describe how light bends when transitioning between boundaries |  |  |  |
| I can predict the direction that light will bend at a medium transition |  |  |  |

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| 3 – Snell’s Law and Critical Angle |  |
| I can mathematically relate the angles of refraction to the indices of refraction for the materials |  |  |  |
| I can describe the phenomenon of Total Internal Reflection |  |  |  |
| I can calculate the critical angle of incidence so that the light cannot escape the medium |  |  |  |
| I can identify applications of total internal reflection and describe their importance |  |  |  |

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| 4 – Diffraction |  |
| I can describe how light bends around a boundary |  |  |  |
| I can describe the interference pattern formed by two coherent waves |  |  |  |
| 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 |  |  |  |

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| 5 – Polarization |
| I can describe the transformation that takes place when unpolarized light is polarized |  |  |  |
| I can describe the interaction between two polarized filters at different orientations |  |  |  |
| I can use Malus’s Law to calculate the change in intensity when passing through polarized filters |  |  |  |

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| **Waves - Light** | Shelving Guide |

## Electromagnetic Spectrum

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| A | Radiowaves |  |
| B | Microwaves |
| C | Infrared |
| D | Visible Light |
| E | Ultraviolet |
| F | X-Rays |
| G | Gamma Waves |

## Index of Refraction

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| --- | --- | --- | --- |
| Medium | Wave Speed (v) | Index of Refraction (n) | $$\frac{n\_{1}}{n\_{2}}=\frac{v\_{2}}{v\_{1}}$$ |
| Vacuum | 3.00 × 108 m s-1 | 1.0000 |
| Air | 2.999 × 108 m s-1 | 1.0003 |
| Water | 2.256 × 108 m s-1 | 1.33 |
| Glass | 1.974 × 108 m s-1 | 1.52 |

## Refraction

|  |  |  |
| --- | --- | --- |
| $$\frac{n\_{1}}{n\_{2}}=\frac{sinθ\_{2}}{sinθ\_{1}}$$ |  |  |
|  |  |

## Reflection

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| --- | --- |
| Law of Reflection |  |
| Angle of Incidence = Angle of Reflection |

Critical Angle

|  |  |  |
| --- | --- | --- |
| When $θ\_{1}=θ\_{c}$ $$θ\_{2}=90°$$ | $$θ\_{c}= sin^{-1}\left(\frac{n\_{2}}{n\_{1}}\right)$$ |  |

Polarized Light

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| --- | --- |
| $$I=I\_{0}cos^{2}θ$$ |  |
| I | Intensity Observed |
| I0 | Original Intensity |
| θ | Difference in Angle |

## Double Slit Experiment

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| $$s=\frac{λD}{d}$$ | Label this diagram: |
| s | Distance between fringes |
| λ | Wavelength |
| D | Distance to Screen |
| d | Distance between slits |