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

# Big Ideas

* Simple harmonic motion is a repeating relationship between an object’s position, velocity, and acceleration
* Waves are formed and transferred by particles oscillating in a medium
* All waves have properties can be measured and mathematically related
* Instruments resonate at specific frequencies due to the number of standing waves that fit in the length of the system
* Waves can occupy the same space at the same space to create constructive or destructive interference

# Content Objectives

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| 1 – Simple Harmonic Motion |  |
| I can qualitatively describe the motion of an oscillating system |  |  |  |
| I can relate the acceleration of an object in simple harmonic motion to its position |  |  |  |
| I can graph the displacement, velocity, and acceleration vs time for simple harmonic motion |  |  |  |
| I can interpret an SHM graph to describe the conditions at a specific point in an object’s motion |  |  |  |
| I can describe and relate the properties of period and frequency |  |  |  |
| I can calculate period and frequency from a scenario |  |  |  |
| I can qualitatively describe the energy changes that take place during an oscillation |  |  |  |

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| 2 – Properties of Traveling Waves |  |
| I can describe how waves carry energy through a medium |  |  |  |
| I can compare the properties of transverse and longitudinal waves |  |  |  |
| I can read a wave’s amplitude, wavelength, period, and frequency from a graph |  |  |  |
| I can label a graph with the location of a wave’s crest/compression and trough/rarefaction |  |  |  |
| I can describe the number of complete wavelengths represented in a picture |  |  |  |
| I can use the wave speed equation to mathematically relate speed, wavelength, and frequency |  |  |  |
| I can relate pitch and frequency for sound waves |  |  |  |

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| 3 – Sound |  |
| I can describe why sound travels at different speeds in different media |  |  |  |
| I can calculate how far a distant object is by timing an echo |  |  |  |
| I can describe the motion of a standing wave |  |  |  |
| I can identify and label the node and antinodes on a standing wave diagram |  |  |  |

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| 4 – Instruments |  |
| I can identify and label the node and antinodes on a standing wave diagram |  |  |  |
| I can describe the end conditions and nodes/antinodes for open/closed pipes and vibrating strings |  |  |  |
| I can calculate the wavelength or instrument length of a standing wave for different harmonics |  |  |  |

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| 5 – Wave Interference |  |
| I can qualitatively and quantitatively interpret cases of constructive and destructive interference |  |  |  |
| I can add up two waves with superposition to create a new waveform |  |  |  |
| I can describe applications and real-world examples for wave interference |  |  |  |
| I can use wavelength and source distance to identify maxima and minima for interference |  |  |  |

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| **Waves - Sound** | Shelving Guide |

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| --- | --- | --- | --- | --- |
|  | Variable Symbol | Unit |  | *Data Booklet Equations:* |
| Period | T | s |  | $$T=\frac{1}{f}$$ |
| Frequency | *f* | Hz |  |
| Wavelength | λ | m |  | $$c=fλ$$ |
| Amplitude | A | m |  |  |
| Wave Speed | v | m s-1 |  |  |

## Simple Harmonic Motion Graphs

|  |  |
| --- | --- |
|  | Velocity vs Displacement |
| Accel. vs Displacement |
| Types of Waves | Picture | Definition | Examples |
| Transverse | https://sites.google.com/site/waveslightandsoundunit/_/rsrc/1467886271961/03---unit-lessons/03---sound-waves/Wave%20-%20Sound%20wave.gif?height=204&width=357 | Particles move **perpendicular** to the motion of the wave | * Light
* Ripples in a Pond
* Earthquakes
 |
| Longitudinal  | https://sites.google.com/site/waveslightandsoundunit/_/rsrc/1467886271961/03---unit-lessons/03---sound-waves/Wave%20-%20Sound%20wave.gif?height=204&width=357 | Particles move **parallel** to the motion of the wave | * Sound
* Earthquakes
 |

## Parts of a Wave

|  |  |
| --- | --- |
| Label the Wave:* Amplitude
* Wavelength
* Crest
* Trough
 |  |

## Harmonics

|  |  |  |  |
| --- | --- | --- | --- |
|  | Open Pipe | Closed Pipe | String |
| End Conditions | Antinode | Antinode | Node | Antinode | Node | Node |
| 3rd Harmonic |  |  |  |
| $$L=\frac{3}{2} λ$$ | $$L=\frac{5}{4} λ$$ | $$L=\frac{3}{2} λ$$ |
| 2nd Harmonic |  |  |  |
| $$L=1 λ$$ | $$L=\frac{3}{4} λ$$ | $$L=1 λ$$ |
| 1st Harmonic(Fundamental) |  |  |  |
| $$L=\frac{1}{2} λ$$ | $$L=\frac{1}{4} λ$$ | $$L=\frac{1}{2} λ$$ |

## Interference

|  |  |  |  |
| --- | --- | --- | --- |
| Constructive | Path Difference = *n λ* | Destructive | Path Difference = (*n* + ½) *λ* |
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