## Summary

### Topic 4 - Oscillations and waves

| Subject | Year | Start date | Duration |
|---|---|---|---|
| Physics | IB1, IB2 | Week 4, November | 4 weeks 15 hours |

Course Part

Core

## Curriculum

### Aims

Appreciate scientific study and creativity within a global context through stimulating and challenging opportunities

Acquire a body of knowledge, methods and techniques that characterize science and technology

Apply and use a body of knowledge, methods and techniques that characterize science and technology

Develop an ability to analyse, evaluate and synthesize scientific information

Develop a critical awareness of the need for, and the value of, effective collaboration and communication during scientific activities

Develop experimental and investigative scientific skills including the use of current technologies

Develop and apply 21st century communication skills in the study of science

Become critically aware, as global citizens, of the ethical implications of using science and technology

Develop an appreciation of the possibilities and limitations of science and technology

Develop an understanding of the relationships between scientific disciplines and their influence on other areas of knowledge

### Objectives

**Demonstrate knowledge and understanding of**

- facts, concepts and terminology
- methodologies and techniques
- communicating scientific information

**Apply**

- facts, concepts and terminology
- methodologies and techniques
- methods of communicating scientific information

## Syllabus Content

**Core**

4. Waves

4.1 – Oscillations

Nature of science:

The concept of momentum and the principle of momentum conservation can be used to analyse and predict the outcome of a wide range of physical interactions, from macroscopic motion to microscopic collisions.

Understandings:

Simple harmonic oscillations

Time period, frequency, amplitude, displacement and phase difference

Conditions for simple harmonic motion

Applications and skills:

Qualitatively describing the energy changes taking place during one cycle of an oscillation

Sketching and interpreting graphs of simple harmonic motion examples

4.2 – Travelling waves

Nature of science:

Patterns, trends and discrepancies: Scientists have discovered common features of wave motion through careful observations of the natural world, looking for patterns, trends and discrepancies and asking further questions based on these findings.

Understandings:

Travelling waves

Wavelength, frequency, period and wave speed

Transverse and longitudinal waves

The nature of electromagnetic waves

The nature of sound waves

Applications and skills:

Explaining the motion of particles of a medium when a wave passes through it for both transverse and longitudinal cases

Sketching and interpreting displacement–distance graphs and displacement–time graphs for transverse and longitudinal waves

Solving problems involving wave speed, frequency and wavelength

Investigating the speed of sound experimentally

4.3 – Wave characteristics

Nature of science:

Imagination: It is speculated that polarization had been utilized by the Vikings through their use of Iceland Spar over 1300 years ago for navigation (prior to the introduction of the magnetic compass). Scientists across Europe in the 17th–19th centuries continued to contribute to wave theory by building on the theories and models proposed as our understanding developed.

Understandings:

Wavefronts and rays

Amplitude and intensity

Superposition

Polarization

Applications and skills:

Sketching and interpreting diagrams involving wavefronts and rays

Solving problems involving amplitude, intensity and the inverse square law

Sketching and interpreting the superposition of pulses and waves

Describing methods of polarization

Sketching and interpreting diagrams illustrating polarized, reflected and transmitted beams

Solving problems involving Malus's law

4.4 – Wave behaviour

Nature of science:

Competing theories: The conflicting work of Huygens and Newton on their theories of light and the related debate between Fresnel, Arago and Poisson are demonstrations of two theories that were valid yet flawed and incomplete. This is an historical example of the progress of science that led to the acceptance of the duality of the nature of light.

Understandings:

Reflection and refraction

Snell's law, critical angle and total internal reflection

Diffraction through a single-slit and around objects

Interference patterns

Double-slit interference

Path difference

Applications and skills:

Sketching and interpreting incident, reflected and transmitted waves at boundaries between media

Solving problems involving reflection at a plane interface

Solving problems involving Snell's law, critical angle and total internal reflection

Determining refractive index experimentally

Qualitatively describing the diffraction pattern formed when plane waves are incident normally on a single-slit

Quantitatively describing double-slit interference intensity patterns

4.5 – Standing waves

Nature of science:

Common reasoning process: From the time of Pythagoras onwards the connections between the formation of standing waves on strings and in pipes have been modelled mathematically and linked to the observations of the oscillating systems. In the case of sound in air and light, the system can be visualized in order to recognize the underlying processes occurring in the standing waves.

Understandings:

The nature of standing waves

Boundary conditions

Nodes and antinodes

Applications and skills:

Describing the nature and formation of standing waves in terms of superposition

Distinguishing between standing and travelling waves

Observing, sketching and interpreting standing wave patterns in strings and pipes

Solving problems involving the frequency of a harmonic, length of the standing wave and the speed of the wave

## ATL Skills

### Approaches to Learning

**Thinking**

- In this unit, we will
  - ask students to formulate a reasoned argument to support their opinion or conclusion
  - give students time to think through their answers before asking them for a response
  - reward a new personal understanding, solution or approach to an issue
  - ask open questions
  - set students a task which required higher-order thinking skills (such as analysis or evaluation)
  - build on a specific prior task
  - help students to make their thinking more visible (for example, by using a strategy such as a thinking routine)
  - require students to take an unfamiliar viewpoint into account when formulating arguments
  - ask questions that required the use of knowledge from a different subject from the one you are teaching
  - include a reflection activity
  - make a link to TOK

**Social**

- In this unit, we will
  - have students work in small groups
  - allocate, or ask students to allocate among themselves, different roles in a classroom discussion or activity
  - have students peer assess their group performance or process
  - support students in resolving a conflict in a team
  - give a group assessment task
  - give students feedback on how they worked as a group
  - have students discuss their understanding of a text or idea among themselves and come up with a shared understanding
  - provide an opportunity for students to analyse the impact of their behaviour on the class or on a group performance
  - encourage students to consider alternative points of view or to take the perspective of others
  - provide opportunities for students to make decisions

## Developing IB Learners

### Learner Profile


Inquirers


Knowledgeable


Thinkers


Communicators


Reflective