Summary

Topic 9 - Wave Phenomena

Subject	Year	Start date	Duration
Physics	IB1, IB2	Week 1, January	5 weeks 17 hours

Course Part

Additional

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

Additional higher level

9. Wave phenomena

9.1 – Simple harmonic motion

Nature of science:

Insights: The equation for simple harmonic motion (SHM) can be solved analytically and numerically. Physicists use such solutions to help them to visualize the behaviour of the oscillator. The use of the equations is very powerful as any oscillation can be described in terms of a combination of harmonic oscillators. Numerical modelling of oscillators is important in the design of electrical circuits.

Understandings:

The defining equation of SHM

Energy changes

Applications and skills:

Solving problems involving acceleration, velocity and displacement during simple harmonic motion, both graphically and algebraically

Describing the interchange of kinetic and potential energy during simple harmonic motion

Solving problems involving energy transfer during simple harmonic motion, both graphically and algebraically

9.2 – Single-slit diffraction

Nature of science:

Development of theories: When light passes through an aperture the summation of all parts of the wave leads to an intensity pattern that is far removed from the geometrical shadow that simple theory predicts.

Understandings:

The nature of single-slit diffraction

Applications and skills:

Describing the effect of slit width on the diffraction pattern

Determining the position of first interference minimum

Qualitatively describing single-slit diffraction patterns produced from white light and from a range of monochromatic light frequencies

9.3 – Interference

Nature of science:

Curiosity: Observed patterns of iridescence in animals, such as the shimmer of peacock feathers, led scientists to develop the theory of thin film interference. Serendipity: The first laboratory production of thin films was accidental.

Understandings:

Young's double-slit experiment

Modulation of two-slit interference pattern by one-slit diffraction effect

Multiple slit and diffraction grating interference patterns

Thin film interference

Applications and skills:

Qualitatively describing two-slit interference patterns, including modulation by one-slit diffraction effect

Investigating Young's double-slit experimentally

Sketching and interpreting intensity graphs of double-slit interference patterns

Solving problems involving the diffraction grating equation

Describing conditions necessary for constructive and destructive interference from thin films, including phase change at interface and effect of refractive index

Solving problems involving interference from thin films

9.4 – Resolution

Nature of science:

Improved technology: The Rayleigh criterion is the limit of resolution. Continuing advancement in technology such as large diameter dishes or lenses or the use of smaller wavelength lasers pushes the limits of what we can resolve.

Understandings:

The size of a diffracting aperture

The resolution of simple monochromatic two-source systems

Applications and skills:

Solving problems involving the Rayleigh criterion for light emitted by two sources diffracted at a single slit

Resolvance of diffraction gratings

9.5 – Doppler effect

Nature of science:

Technology: Although originally based on physical observations of the pitch of fast moving sources of sound, the Doppler effect has an important role in many different areas such as evidence for the expansion of the universe and generating images used in weather reports and in medicine.

Understandings:

The Doppler effect for sound waves and light waves

Applications and skills:

Sketching and interpreting the Doppler effect when there is relative motion between source and observer

Describing situations where the Doppler effect can be utilized

Solving problems involving the change in frequency or wavelength observed due to the Doppler effect to determine the velocity of the source/observer

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


Reflective