IB PHYSICS 12
COURSE OUTLINE--- *2024/2025*

Teacher: Mr. Halabi

Welcome to IB Physics 11/12 at Semiahmoo Secondary School. This is a 2.5 semester course over the Gr. 11 & 12 years; actual coverage in each semester may vary from the given outline. At the end of this course, you will have covered a broader range of topics than required by the British Columbia Ministry of Education Provincial Curriculum. Refer to 'IB Physics 12 – Topics' for topics.

General goals of the course are to provide the student with

- Knowledge of Physics
- Thinking and analytic skills (theory and hands-on) to manipulate the knowledge
- An awareness of science in our daily lives
- A solid foundation for pursuing post-secondary sciences studies

Aims for the Group 4 (intended for Physics here):

Through studying biology, chemistry or physics, students should become aware of how scientists work and communicate with each other. While the scientific method may take on a wide variety of forms, it is the emphasis on a practical approach through experimental work that characterizes these subjects.

The course enables students, through the overarching theme of the NOS, to:

1. develop conceptual understanding that allows connections to be made between different areas of the subject, and to other DP sciences subjects
2. acquire and apply a body of knowledge, methods, tools and techniques that characterize science
3. develop the ability to analyse, evaluate and synthesize scientific information and claims
4. develop the ability to approach unfamiliar situations with creativity and resilience
5. design and model solutions to local and global problems in a scientific context
6. develop an appreciation of the possibilities and limitations of science
7. develop technology skills in a scientific context
8. develop the ability to communicate and collaborate effectively
9. develop awareness of the ethical, environmental, economic, cultural and social impact of science.

Assessment objectives:

The assessment objectives for physics reflect those parts of the aims that will be formally assessed either internally or externally. It is the intention of this course that students are able to fulfil the following assessment objectives.

1. Demonstrate knowledge of:
    a. terminology, facts and concepts
    b. skills, techniques and methodologies.
2. Understand and apply knowledge of:
    a. terminology and concepts
    b. skills, techniques and methodologies.
3. Analyse, evaluate, and synthesize:
    a. experimental procedures
    b. primary and secondary data
    c. trends, patterns and predictions.
4. Demonstrate the application of skills necessary to carry out insightful and ethical investigations.

Assessment objectives in practice

Assessments align with the course's aims, objectives, and conceptual approach; the NOS and subject-specific skills are also assessed. This allows students to demonstrate learning effectively through varied tasks that are reliably and accurately marked or moderated by subject-area educators and experts.

Assessment objective	**Which component addresses this assessment objective?**	**How is the assessment objective addressed?**
AO1 Demonstrate knowledge	Paper 1 Paper 2 Scientific investigation	Students respond to a range of multiple-choice, short-answer questions and extended-response questions. Students investigate and answer a research question that is their own.

AO2 Understand and apply knowledge	Paper 1 Paper 2 Scientific investigation	Students respond to a range of multiple-choice, short-answer, data-based and extended-response questions. Students investigate and answer a research question that is their own.
AO3 Analyse, evaluate, and synthesize	Paper 1 Paper 2 Scientific investigation	Students respond to a range of multiple-choice, short-answer, data-based and extended-response questions. Students investigate and answer a research question that is their own.
AO4 Demonstrate the application of skills necessary to carry out insightful and ethical investigations	Scientific investigation	Students investigate and answer a research question that is their own.

Component	**Approximate weighting of assessment objectives (%)**	
	AO1 + AO2	**AO3**
Paper 1	50	50
Paper 2	50	50
Internal assessment	Covers AO1, AO2, AO3 and AO4	

Syllabus outline, Road Map & Format

A. Space, time and motion	B. The particulate nature of matter	C. Wave behaviour	D. Fields	E. Nuclear and quantum physics
A.1 Kinematics A.2 Forces and momentum A.3 Work, energy and power A.4 Rigid body mechanics A.5 Galilean and special relativity	B.1 Thermal energy transfers B.2 Greenhouse effect B.3 Gas laws B.4 Thermodynamics B.5 Current and circuits	C.1 Simple harmonic motion C.2 Wave model C.3 Wave phenomena C.4 Standing waves and resonance C.5 Doppler effect	D.1 Gravitational fields D.2 Electric and magnetic fields D.3 Motion in electromagnetic fields D.4 Induction	E.1 Structure of the atom E.2 Quantum physics E.3 Radioactive decay E.4 Fission E.5 Fusion and stars

This is the overarching theme.

This is the name of the topic.

Guiding questions frame the topic—by studying the topic students will be able to answer the question(s) with increasing depth.

Understandings list specific areas to be taught.

Standard level and higher level: 3 hours

3 hours total teaching is recommended, whether for standard level (SL) or higher level (HL).

Additional higher level is content for that level only.

Guidance provides clarifications and limitations to the topic.

Linking questions link one topic to another in physics or, when indicated by "(NOS)", the nature of science. They signpost related content and problem-solving beyond immediate content. Teachers and students are encouraged to create their own linking questions.

C. Wave behaviour

C.1 Simple harmonic motion

Guiding questions

What makes the harmonic oscillator model applicable to a wide range of physical phenomena?

Understandings

Standard level and higher level: 3 hours

Students should understand:

- conditions that lead to simple harmonic motion

Additional higher level: 4 hours

Students should understand:

- that a particle undergoing simple harmonic motion can be described using phase angle

Guidance

The significance of the minus sign in the defining equation for simple harmonic motion should be understood.

Linking questions

How can greenhouse gases be modelled as simple harmonic oscillators?

What physical explanation leads to the enhanced greenhouse effect? (NOS)

s component	Teaching Hours HL
s content	**180**
e, time and motion	42
particulate nature of	32
	29
e behaviour	38
s	39
ear and quantum	
nental programme	**60**
l work	40
rative sciences project	10
ic investigation	10
aching hours	**240**

Example topic sequence

- A1 → A2 → A3 → D1
- B5 → D2 → D3 → D4
- B1 → B2 → B3 → B4
- C1 → C2 → C3 → C4 → C5
- E1 → E2 → E3 → E4 → E5
- A4 → A5

Table 4

Physics syllabus content overview

A. Space, time and motion	B. The particulate nature of matter	C. Wave behaviour	D. Fields	E. Nuclear and quantum physics
A.1 Kinematics •	B.1 Thermal energy transfers •	C.1 Simple harmonic motion ••	D.1 Gravitational fields ••	E.1 Structure of the atom ••
A.2 Forces and momentum •	B.2 Greenhouse effect •	C.2 Wave model •	D.2 Electric and magnetic fields ••	E.2 Quantum physics •••
A.3 Work, energy and power •	B.3 Gas laws •	C.3 Wave phenomena ••	D.3 Motion in electromagnetic fields •	E.3 Radioactive decay ••
A.4 Rigid body mechanics •••	B.4 Thermodynamics •••	C.4 Standing waves and resonance •	D.4 Induction •••	E.4 Fission •
A.5 Galilean and special relativity •••	B.5 Current and circuits •	C.5 Doppler effect ••		E.5 Fusion and stars •

• Topics with content that should be taught to all students

•• Topics with content that should be taught to all students plus additional HL content

••• Topics with content that should only be taught to HL students

Source: Physics Subject Guide (first assessment 2025), IBO

Conceptual approach

Many sub-topics can be interpreted under one of the three conceptual approaches.

Theme	Concept of energy	Concept of particles	Concept of force
	B.2 Greenhouse effect B.3 Gas laws B.4 Thermodynamics B.5 Current and circuits	B.2 Greenhouse effect B.3 Gas laws B.5 Current and circuits	B.3 Gas laws B.4 Thermodynamics B.5 Current and circuits
C. Wave behaviour	C.1 Simple harmonic motion C.2 Wave model C.4 Standing waves and resonance	C.1 Simple harmonic motion C.2 Wave model C.4 Standing waves and resonance	C.1 Simple harmonic motion C.4 Standing waves and resonance
D. Fields	D.1 Gravitational fields D.2 Electric and magnetic fields D.4 Induction	D.3 Motion in electromagnetic fields	D.1 Gravitational fields D.2 Electric and magnetic fields D.3 Motion in electromagnetic fields
E. Nuclear and quantum physics	E.1 Structure of the atom E.2 Quantum physics E.3 Radioactive decay E.4 Fission E.5 Fusion and stars	E.1 Structure of the atom E.2 Quantum physics	E.3 Radioactive decay

Source: Physics TSM (first assessment 2025), IBO

Connections to the core of the IB Diploma:

Approaches to Teaching & Learning (ATL)

Approaches to Teaching: There are 6 key principles to the approaches to teaching IB courses, the programme should be:

- Based on inquiry
- Focused on Conceptual Understanding
- Developed in local and global Context
- Focused on effective teamwork and collaboration
- Differentiation to meet the needs of all learners
- Informed by Assessment (formative and summative).

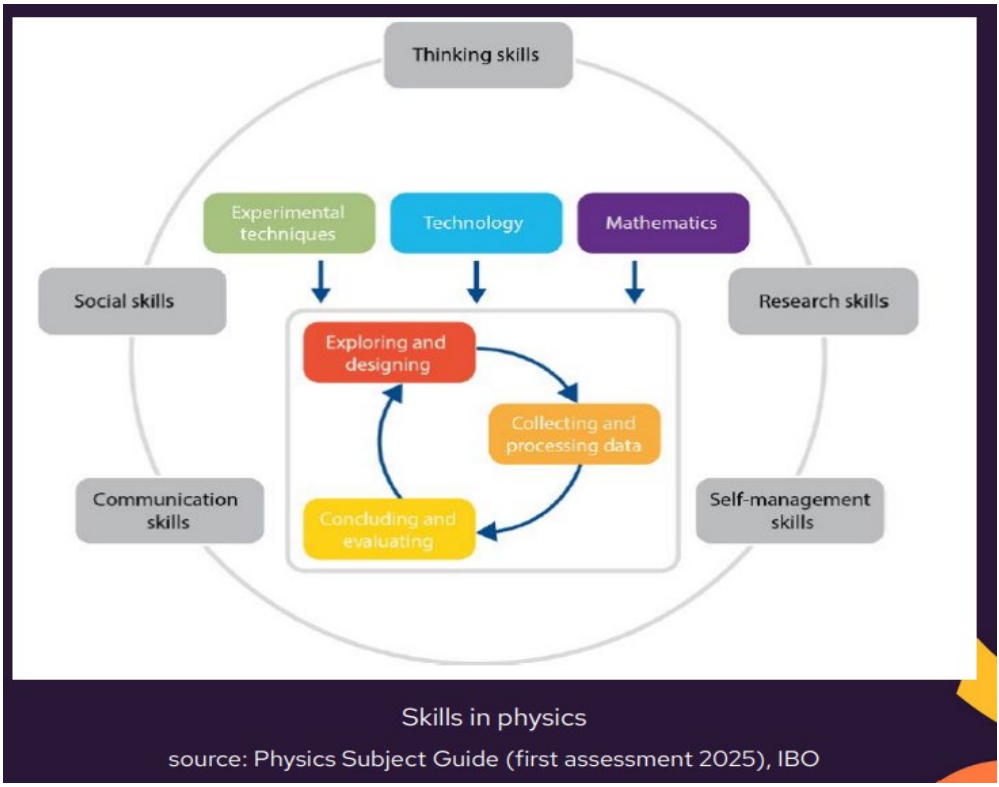
This doesn't mean that every lesson has to incorporate all of these components, but the complete 2-year course will.

Approaches to teaching refers to the way we present the course, approaches to learning is about the way it is received. To receive the knowledge presented by the teacher a student must have certain skills, these can be classified in 3 ways:

- Cognitive - thinking skills, problem solving, understanding concepts.
- Metacognitive - an awareness of the different thought processes required for different tasks, thinking about thinking.
- Affective - handling emotions and behaviour.

The IB document **Approaches to teaching and learning** classifies these skills into 5 overlapping areas:

- Thinking skills,
- Communication skills,
- Social skills,
- Self management skills
- research skills



Skills in physics
source: Physics Subject Guide (first assessment 2025), IBO

Theory of Knowledge (TOK)

In TOK speak, physics is an area of knowledge, so some time will be spent in the TOK classroom discussing physics as a natural science. Here are a few of the kind of questions that will come up in TOK.

Nature of physics:

- Why is physics called a "natural science"? What is and isn't physics?
- In physics are there any assumptions that are unprovable?

Methods of gaining knowledge:

- What is meant by the “scientific method”? Is the scientific method the same in all sciences? Is the scientific method the same in all cultures?
- Are the methods used in physics the same as in other sciences? What are the implications of any variations? For example, when analysing data in physics are the same methods used as in biology? How many laws of biology are there? What kinds of reasoning are used in physics?
- Physics is an experimental science, what counts as an experiment? Can experiments be undertaken in history? Can experiments be carried out in cosmology?

Knowledge claims:

- In physics we use theories and laws to make explanations, is this the same in other subjects?
- To what extent can all the natural sciences be understood through the study of just one science, for example, physics? If biology relies on chemistry, and chemistry relies on physics, can it be said that all-natural sciences are reducible to physics? If so, what would be the implications of this position?

Natural sciences and values:

- Should physics be allowed to progress without regulation, or should there be some independent body that controls the direction of research? Should the funding of research be decided by business or governments?
- Are physicists morally responsible for the application of their discoveries? If someone is to be held responsible for the atom bomb how far back should be go, Bohr, Rutherford, Thomson? Should research in physics ever be stopped on moral grounds?

Physics and technology:

- Is scientific knowledge valued more for its own sake or for the technology that it makes possible? Is there any science that can be pursued without the use of technology?
- Advances in physics often lead to advancements in technology such as the mobile phone. Does it matter that although most people use a mobile phone few people understand the physical principles that it operates on. What is the difference between science and technology? Are science and technology inseparable?

Metaphor and reality:

- In physics we make great use of metaphors and analogies, gas atoms like lots of little bouncy balls, light like ripples spreading out on the surface of a pond etc. Could we have physics without analogies? Does the use of analogy ever cause problems? Is understanding the model the same as understanding reality?
- In physics, computer simulations and animations help us visualise things that we can't see. Is visualisation important? Can we understand something that we can't see? Have computer simulations removed the need for imagination?

This course requires a great deal of self-discipline from the student in terms of studying, homework, review, and self-assessment. It is essential the student always remains up to date by **reviewing materials and lessons daily (OneNote is used for classroom notes & ManageBac will be used for all file uploads and submissions)** and seeks clarification on concepts and problems by asking questions in class or in Teams.

Each lesson builds on previous lessons; therefore, it is imperative that you identify areas of confusion and difficulties and not allow them to persist, **ask questions! I am available for help every day early morning or after school in person, when possible, or Conferencing via Teams – please don't hesitate to come in for help or ask via Teams in our class chat. Do not let yourself fall behind. You can also email questions to me at elhalabi_l@surreyschools.ca, I will respond as quickly as possible.**

Absences from class

Every class is a valuable class and therefore missing a class means you will miss something, possibly causing you to fall behind. If you do miss a class ensure you obtain from a reliable student the notes that were given and review those notes. **Notes are available on OneNote and in Class Teams**. If you still have difficulties after reviewing the notes please see me (contact me) for clarifications.

It is also your responsibility to:

i) find out about dates regarding quizzes, tests and assignments (Posted in ManageBac)
ii) to catch up

Missed Evaluations: If you miss a test or quiz due to an absence, you will be given a 'Null' mark. To be considered for a rewrite, rescheduling, or omitting of a mark, a **Parent or Guardian must make written contact with me within 3 school days.** I believe that open communication is the best way to resolve any concern.

Late Assignments: If I have returned the assignment, or if two school days have elapsed, then the assignment will not be accepted. **Acceptance will require a written explanation from your Parent / Guardian.** Late work will be treated accordingly and may be subject to academic malpractice.

Expectations

- Mature behavior and common sense is expected at all times.
- I expect you to come to class with an attitude of achievement. Respect yourself and conduct yourself with pride and dignity.
- Respect the needs of your fellow students and others' right to learn.
- I expect a focused academic tone as senior students.
- Arrive to class on time and ready to work.
- I expect active participation in class discussion and questions in person OR online.
- Handle all lab equipment with care and precaution.
- I expect from you: HONESTY, SELF DISCIPLINE, and the DRIVE TO SUCCEED.

Academic Integrity and AI

Guidelines for Semiahmoo Students

The use of AI tools (such as Chat GPT) by students in the Semiahmoo IB Programme are subject to both our own Academic Integrity Policy as well as the broader IB Academic Integrity Policy. These policies clearly outline expectations for fair use of AI tools as well as what types of use are not acceptable. Please refer to the detailed Academic Integrity document published on the schools' IB website.

Semiahmoo Digital Device Policy

https://www.surreyschools.ca/semiahmoo/page/9641/policies-procedures

Most students at Semiahmoo now carry cell phones and other electronic devices. It is our expectation that students use them respectfully.

· Cell phones and other electronic devices are to be turned off and out of sight during all school instructional time including classes, assemblies, field trips, etc.

· Cell phones and other electronic devices are banned from examinations and tests.

· Cell phones and other electronic devices may only be used during instructional time if directed by the teacher.

· The video and camera component of electronic devices may not be used on school property without prior consent.

If students are using their cell phones and other electronic devices in an inappropriate manner, teachers may hold them for a specified period of time. Parents will be contacted if necessary.

Mark Breakdown	
Homework, Labs & Projects	25 %
Quizzes	25 %
Unit Exams	50 %
Class Mark Total	100 %

IB PHYSICS 11 &12 – TOPICS

Note: As the IB Physics HL Syllabus is covered in about 2.5 semesters over the grade 11 & 12 years, actual coverage in this outline may vary depending on time and needs of students.
Here is a link to the IB Physics Guide- First assessment 2025

https://padlet.com/wongl21/what-s-changing-in-ib-dp-physics-tt720q7cbszmvx4p/wish/2621130263

Syllabus	***GRADE 11 Topics*** ***A1→A2→A3→B1→C2→C3→C4***
	A. Space, time, and motion
Introduction	***Measurement & Uncertainties***
I.0	Manipulating Equations
I.00	Trigonometry Review
I.1	Measurements in Physics
I.2	Uncertainties & Errors
I.3	Vectors and scalars
A.1	***Kinematics***
A.2	***Forces & Momentum***
A.3	***Work, Energy & Power***
	B. The Particulate nature of matter
B.1	***Thermal Energy Transfers***
	C. Wave Behaviour
C.2	***Wave Model***
C.3	***Wave Phenomena***
C.4	***Standing Waves & Resonance***
Syllabus	***GRADE 12 Topics*** ***A2→A3→A2→D1→A4→B1→B2→B3→B4→ C1→C2→C3→C4→ C5→D2→B5→D2→ D3→D4→E1→E2→ E3→E4→E5→&→ A5***
	A. Space, time, and motion
A.2	***Forces, Dynamics & Momentum (REVIEW)***
A.3	***Work, Energy & Power (REVIEW)***

A.2	***2-D Momentum & Circular Motion***
	D. Fields (Gravitational part)
D.1	***Gravitational Fields***
A.4	***Rigid Body Mechanics***
	B. The Particulate nature of matter
B.1	***Thermal Energy Transfers***
B.2	***Greenhouse effect***
B.3	***Gas Laws***
B.4	***Thermodynamics***
	C. Wave Behaviour
C.1	***Simple Harmonic Motion***
C.2	***Wave Model (REVIEW)***
C.3	***Wave Phenomena (REVIEW)***
C.4	***Standing Waves & Resonance (REVIEW)***
C.5	***Doppler Effect***
	D. Fields (Electric & Magnetic)
D.2	***Electric Fields***
B.5	***Current & Electricity***
D.2	***Magnetic Fields***
D.3	***Motion in Electromagnetic Fields***
D.4	***Induction***
	E. Nuclear & Quantum Physics
E.1	***Structure of the Atom***
E.2	***Quantum Physics***
E.3	***Radioactive Decay***
E.4	***Fission***
E.5	***Fusion & Stars***
A.5	***Galilean & Special Relativity***

The flow chart below is part of an interactive flow chart showing the scientific process of inquiry in practice. The interactive version can be found at “How science works: The flowchart.” Understanding Science. University of California Museum of Paleontology. 1 February 2013 <http://undsci.berkeley.edu/article/scienceflowchart>.

How science works