IB DIPLOMA COURSE OUTLINE 2021 – 22

Subject group and course title: Group 4 - Physics

Course purpose:

Physics is at the root of all sciences. It reflects the timeless journey of humans in search of answers to all the fundamental questions that mystified them throughout the millennia: ‘’who are we ‘’, where do we come from’’, ‘’how does the universe and all things in it work’’?

Students studying IB Physics in Platon begin their course through an extensive general introduction that offers them multiple links to many other expressions of human inquiry. They will then be introduced to a wide range of scientific concepts and they will develop a variety of skills ranging from practical to generic transferable skills that will help them develop a round personality.

Topics covered (in order taught during the two years)

The course offers an overview of most of the fundamental principles of Physics, ranging from Measurements and Error Propagation to Mechanics, including Forces, motion in one and two dimensions, Projectile and Circular motion and expanding to Motion in Gravitational Fields for the HL students.

Following up, all students will learn about Thermal Physics and Ideal Gases, Oscillations & Waves and the phenomena relating to them such as Refraction, Diffraction, Interference, Polarisation, the Doppler Effect etc. HL students will investigate these phenomena in greater detail.

At the beginning of the second year an overview of Electromagnetism will provide the students with the fundamentals of Static Electricity and Electric Current, while HL students will also have the chance to learn about Electromagnetic Induction, Alternating Current and Electrical Power Transmission as well as Capacitors.

One of the most exciting parts of the course involves the so called “modern physics” and in particular the Core topic of Atomic, Nuclear and Particle Physics. Students following HL will also come across the wonders of Quantum Mechanics and will get a closer look into the interactions between light and matter through the investigation of the Photoelectric Effect.

Finally, a short but crucial topic will deal with Energy Production and its impact on the planet, before moving to the Options where the students can choose between the Theory of Relativity, Engineering Physics, Imaging and Astrophysics.

Assessment model

The performance of students is constantly monitored through a range of formative assessment tasks including tailor made worksheets that cover each topic and sub-topic as well as online multiple-choice quizzes.

Students will be assigned homework almost after every class since the course is highly demanding and requires a lot of practice. Their work however is not delivered as homework to be marked by the teacher

but it is assessed in class through Socratic debates.

Students will be asked to justify their answers even if correct but they will also be encouraged to examine all the steps that led them to a wrong answer. This is done by asking them several questions and leading them to find the correct answer themselves. Through this process every student in class benefits and difficult concepts are decomposed into a sequence of manageable logical steps. The process is orchestrated by the teacher but is led by the students.

Formative assessment is done in the form of end-of-unit tests as well as through the main exams following the official exam cycles of the IB DP Department.

How are key concepts served (methodology)?

All three key concepts for sciences (change, relationships, systems) are encountered throughout the course. Change is one of the most important key concepts in Physics since many of the phenomena discussed involve the change of a physical quantity with time.

Relationships is also at the heart of Physics. Given the fact that the tens of physical quantities used in physics all stem from only seven base quantities one can understand that the concept of relationships runs through the fabric of Physics. In addition, experimental evidence is the only way of establishing new physical laws and it is based in the observation of the relationships between different variables. Last but not least, the key concept of relationships, in its broader context, is surfacing in almost every part of the course since Physics relates directly to the technological development of societies and this in turn affects, in a profound way, the socioeconomical as well as the historical developments at a global scale.

Finally, the concept of systems is also encountered frequently in Physics, since phenomena are usually observed in the context of a given system. From the Law of Conservation of Momentum that holds for isolated systems, to the Ideal Gas that is represented as a system of tiny masses having well defined properties, to the Conservation of Energy in the Universe, systems are of paramount importance in the study of Physics.

How does the course foster international mindedness?

Global warming, renewable energy sources, the use of atomic energy, space exploration, common and globally accepted units of measurement, the global quest for fusion energy through international collaboration, the search for life in other parts of the universe, the access to scientific discoveries, all those and many more are global issues relating that are discussed during the course and foster international mindedness.

How are IB Learner Profile attributes promoted?

The Physics course remains focused on the IB Learner Profile aiming to make students more knowledgeable in the area of Physics by also promoting all the other attributes that characterize and IB Learner. The students will become natural inquirers as they will have to come up with their own original investigation for their Internal Assessment and execute it successfully. In the process they will have to make their own decisions and take the associated risks.

In many parts of the course the students will come across ethical questions regarding Physics and its applications and, in this way, they will develop a more informed sense of fairness and balance. They will

come across questions with no straightforward answers that will require them to be open-minded. For example, whether, given the current climate emergency, the use of Nuclear Power for energy production should be expanded, despite the associated dangers, as an emergency measure to combat greenhouse emissions, a question to which many, until recently, would provide a negative answer without second thoughts.

Finally, students will be called to communicate their work and their thoughts and be reflective about it. This will be enabled through a range of exercises including presentations and self-reflection forms.

How does the course meet student needs via ATL?

Physics is an experimental science and a significant part of the course is devoted in experimentation. Several ATL skills are developed through this process and complement the skills developed in the class.

In order to perform experimental tasks, students have to develop their thinking skills by interpreting lab instructions, recalling information and applying their knowledge to practical tasks. They will then have to analyze and evaluate the experimental results.

Their social skills develop through collaborative work where they will have to perform tasks as parts of a team, adopting a variety of group roles and engaging with different points of view. They will learn to manage their time effectively, maintain their self-motivation, especially when they work on their own experimental project toward their IA, and persevere when things do not go as planned.

Apart from the skills developed in the lab, students will take part in a range of activities focused on developing their social skills. Those involve for example demonstrating experiments to MYP2 students, doing presentations on interdisciplinary topics etc. Their communication skills will be further enhanced as they will be working on laboratory reports and eventually their IAs where they will have to provide a comprehensive piece of written work through which they will be communicating their research.

Self-management skills will be developed in class but they will be further enhanced through practical work in the lab where the students will learn how to manage their time effectively how to take appropriate safety measures and follow established codes of practise. They will have to work independently for their IAs nevertheless they will have to seek support when needed and make informed choices regarding their research. As it is apparent their endeavours regarding the Internal Assessment will also help them to improve their existing research skills and extend them.

Describe connections with CAS

The course offers many opportunities to for links to CAS. Examples of CAS activities include the long exposure photography (light painting) of an LED light attached to the end of a double-pendulum visualizing the random (chaotic) motion of its end in a highly artistic result. Another student decided to design and 3D print labels in Braille in order to place them in the school and donate them to places where they are needed.

Describe connections with TOK

The IB Diploma Physics course offers excellent opportunities for ToK discussion that really offer the students food for thought. A small sample of the questions that the students will be called to discuss includes the following:

- Are we biased when we perform experiments? Why some of the greatest discoveries happened by chance as the result of apparently failed experiments?

- How do we understand the world? Are there scientific certainties that lie beyond the reach of our senses and abilities?
- What is reality and how does it relate to the ideas of quantum mechanics?
- Should there be limits in science?
- Should there be ethical restrictions in the pursuit of new knowledge?
- Is science providing definite answers to fundamental questions or is it a perpetual quest for new knowledge fueled by the human need to provide a meaning?
- What is the nature of the dynamic relationship between fundamental research and technological advancements?
- What is time?

Recommended resources

Phet, Algodoo, Veritasium, Physics World, Scientific American, Nature, Phyphox, The Physics Teacher

Instructor's name

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