



Insight Academy of Canada

## Course Outline

<b>Course Title</b>	Physics, Grade 12, University Preparation (SPH4U)
<b>Grade</b>	12
<b>Course Type</b>	University
<b>Course Code</b>	SPH4U
<b>Credit Value</b>	1.0
<b>Curriculum Policy Documents</b>	The Ontario Curriculum, Grades 11 and 12: Science, 2008 (revised)  Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools, 2010
<b>Prerequisite(s)</b>	Physics, Grade 11, University Preparation (SPH3U)

## Course Description

This course enables students to deepen their understanding of physics concepts and theories. Students will continue their exploration of energy transformations and the forces that affect motion, and will investigate electrical, gravitational, and magnetic fields and electromagnetic radiation. Students will also explore the wave nature of light, quantum mechanics, and special relativity. They will further develop their scientific investigation skills, learning, for example, how to analyze, qualitatively and quantitatively, data related to a variety of physics concepts and principles. Students will also consider the impact of technological applications of physics on society and the environment.

## Overall Curriculum Expectations

<b>A. Scientific Investigation Skills and Career Exploration</b> Throughout this course, students will:	
A1	Demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating);
A2	Identify and describe careers related to the fields of science under study, and describe the contributions of scientists, including Canadians, to those fields.
<b>B. Dynamics</b> Throughout this course, students will:	
B1	Analyse technological devices that apply the principles of the dynamics of motion, and assess the technologies' social and environmental impact;
B2	Investigate, in qualitative and quantitative terms, forces involved in uniform circular motion and motion in a plane, and solve related problems;
B3	Demonstrate an understanding of the forces involved in uniform circular motion and motion in a plane.
<b>C. Energy and Momentum</b> Throughout this course, students will:	
C1	Analyse, and propose ways to improve, technologies or procedures that apply principles related to energy and momentum, and assess the social and environmental impact of these technologies or procedures;
C2	Investigate, in qualitative and quantitative terms, through laboratory inquiry or computer simulation, the relationship between the laws of conservation of energy and conservation of momentum, and solve related problems;
C3	Demonstrate an understanding of work, energy, momentum, and the laws of conservation of energy and conservation of momentum, in one and two dimensions.
<b>D. Gravitational, Electric and Magnetic Fields</b> Throughout this course, students will:	
D1	Analyse the operation of technologies that use gravitational, electric, or magnetic fields, and assess the technologies' social and environmental impact;

D2	Investigate, in qualitative and quantitative terms, gravitational, electric, and magnetic fields, and solve related problems;
D3	Demonstrate an understanding of the concepts, properties, principles, and laws related to gravitational, electric, and magnetic fields and their interactions with matter.
<b>E. The Wave Nature of Light</b> Throughout this course, students will:	
E1	Analyse technologies that use the wave nature of light, and assess their impact on society and the environment;
E2	Investigate, in qualitative and quantitative terms, the properties of waves and light, and solve related problems;
E3	Demonstrate an understanding of the properties of waves and light in relation to diffraction, refraction, interference, and polarization.
<b>F. Revolutions in Modern Physics: Quantum Mechanics and Special Relativity</b> Throughout this course, students will:	
F1	Analyse, with reference to quantum mechanics and relativity, how the introduction of new conceptual models and theories can influence and/or change scientific thought and lead to the development of new technologies;
F2	Investigate special relativity and quantum mechanics, and solve related problems;
F3	Demonstrate an understanding of the evidence that supports the basic concepts of quantum mechanics and Einstein's theory of special relativity.

## Outline of Course Content

Unit No.	Unit Title	Instructional Time	Overall Expectations
1	Introduction	3 hours	A1, A2
2	Dynamics: Forces and Motions	24 hours	B1, B2, B3
3	Energy and Momentum	24 hours	C1, C2, C3
4	Gravitational, Electric and Magnetic Fields	25 hours	D1, D2, D3
5	The Wave Nature of Light	21 hours	E1, E2, E3
6	Revolutions in Modern Physics: Quantum Mechanics and Special Relativity	13 hours	F1, F2, F3
<b>Total Instructional Time</b>		<b>110 HOURS</b>	
7	Final Exam	2.5 hours	B1 – F3

### Unit Descriptions

The entire course is delivered online

### **Unit 1: Introduction**

Students will review concepts essential to their success in the course: scientific notation, significant digits, vector operations, and fundamental mathematical tools.

**Overall and Specific Expectations: A1, A2**

### **Unit 2: Dynamics: Forces and Motion**

In this unit, students will analyze technological devices that apply the principles of the dynamics of motion, and assess their social and environmental impact. They will investigate, in qualitative and quantitative terms, forces involved in uniform motion in a plane, and solve related problems. To conclude the unit, students will demonstrate an understanding of the forces driving uniform circular motion.

**Overall and Specific Expectations: B1, B2**

### **Unit 3: Energy and Momentum**

In this unit, students will analyze and propose methods to improve, technologies or procedures that apply principles related to energy and momentum, and to assess the social and environmental impact of these technologies or procedures. They will also investigate, in qualitative and quantitative terms, through computer simulation, the relationship between the laws of conservation of energy and momentum, and solve related problems. The unit will conclude with the student demonstrating an understanding of work, energy, momentum, and the laws of conservation of energy and momentum, in one and two dimensions.

**Overall and Specific Expectations: C1, C2, C3**

### **Unit 4: Gravitational, Electric and Magnetic Fields**

Students will study the nature and laws of electrical charges, the law of conservation of charge, electrical forces (Coulomb's Law), electrical fields, electrical potential and the motion of charged particles in an electrical field. Students will demonstrate an understanding of the concepts, properties, principles and laws related to gravitational, and magnetic fields, particularly with respect to their interactions with matter. They will analyze the operation of technologies that use these fields, and discuss the impact of these technologies on society and the environment.

**Overall and Specific Expectations: D1, D2, D3**

### **Unit 5: The Wave Nature of Light**

Students will study light with particular respect to its wave nature. Properties of waves will be discussed in a general sense, and the principles of diffraction, refraction, interference and polarization will be investigated theoretically and through simulation. Technologies that make use of the knowledge of the wave nature of light, and their social and environmental impacts, will be discussed.

**Overall and Specific Expectations: E1, E2, E3**

### **Unit 6: Revolutions in Modern Physics: Quantum Mechanics and Special Relativity**

In this unit, students will investigate some of the most impactful aspects of Physics, including Einstein's ideas about relativity, photoelectric effect, and particle physics. Students will engage in mathematical exercises designed to investigate problems in Quantum Mechanics and Special Relativity. In light of the revolutionary ideas studied in this unit, students will discuss how the introduction of new conceptual models can influence and change scientific thought, and lead to the development of new technologies.

**Overall and Specific Expectations: F1, F2, F3**

## Teaching and Learning Strategies

Effective instruction is key to student success and students learn best when they are engaged in a variety of ways of learning. Teachers at Insight Academy of Canada (IAC) provide numerous opportunities and use a variety of instructional, assessment, and evaluation strategies to help students develop skills of inquiry, problem solving, and communication as they investigate and learn fundamental concepts. The activities offered enable students not only to make connections among these concepts throughout the course but also to relate and apply them to relevant societal, environmental, and economic contexts. Opportunities to relate knowledge and skills to these wider contexts will motivate students to learn and to become lifelong learners.

Each unit of the course contains a Unit Overview, a number of Lessons, a Unit Test, and a Unit Exit Card. Lessons are delivered through the following format.

- **Mind on.** Students are introduced to the content through a variety of exploratory and instructional strategies including watching online videos.
- **Actions.** Students practice and apply their new learning through worked examples, exercises, investigations, explorations, practice quizzes, simulation, research project and virtual lab. Students are actively engaged in their assessment process as they monitor their own learning to determine their next steps and set individual learning goals.
- **Consolidation.** Students are provided opportunities to demonstrate what they have learned through independent practice, reflection assignments, and discussion posts (Exit Slip).
- **Extension Activities.** Students study extra lesson resources, complete homework assignment, and response to teacher's follow-up questions to expand their learning and prepare for unit test.

Along with some of the strategies noted in the assessment and evaluation strategies charts below, teaching and learning strategies will include:

- **Activity Based Strategies:** Student completes assigned activities reflecting the learning goals of the course
- **Cooperative Strategies:** Small group learning providing high levels of student engagement and interdependence through discussion posts/student feedback/debates
- **Direct Instruction Strategies:** Teacher guided instruction on areas for student improvement based on chats, office hours, assignment feedback
- **Independent Learning Strategies:** Students analyze their own strengths and weaknesses through self-assessment
- **Technology and Media Based Applications:** Integrating technology into the course when appropriate is proving to be valuable for enhancing and extending the learning experience for faculty and students.
- **Thinking Skills Strategies:** Independent generation of best learning practices and characteristics

- Inquiry Research Mode: Detailed steps focused upon using sources properly in own work and through feedback from teacher and peer

<b>Activity Based Strategies</b> <ul style="list-style-type: none"> <li>• Panel discussion</li> <li>• Online videos</li> <li>• Articles</li> <li>• Simulation</li> <li>• Online research</li> </ul>	<b>Cooperative Strategies</b> <ul style="list-style-type: none"> <li>• Discussion Posts</li> <li>• Peer Commentary</li> <li>• Peer interactive communication</li> </ul>	<b>Direct Instruction Strategies</b> <ul style="list-style-type: none"> <li>• Lecture</li> <li>• Review</li> <li>• Articles/Videos</li> <li>• Practice and drill</li> <li>• Worksheets</li> <li>• Guided exploration</li> </ul>
<b>Independent Learning Strategies</b> <ul style="list-style-type: none"> <li>• Homework Q&amp;A</li> <li>• Report</li> <li>• Note making</li> <li>• Discussion Posts</li> <li>• Online Research</li> <li>• Summary Review Grids</li> <li>• Online research</li> <li>• Exit Card</li> <li>• ePortfolio</li> <li>• Self-assessment</li> </ul>	<b>Technology and Media Based Applications</b> <ul style="list-style-type: none"> <li>• Homework Q&amp;A online submissions</li> <li>• Independent Reading</li> <li>• Videos Q&amp;A</li> <li>• Discussion Posts</li> <li>• Online Research</li> <li>• Media Presentation (Slideshow)</li> <li>• Simulation</li> <li>• Exploration</li> <li>• Virtual Lab</li> </ul>	<b>Thinking Skills Strategies</b> <ul style="list-style-type: none"> <li>• Graphing</li> <li>• Experimenting</li> <li>• Sharing opinions/offering commentary</li> <li>• Brainstorming</li> <li>• Questionnaires/Self reflection</li> <li>• Problem Solving</li> <li>• Case Study Analysis</li> <li>• Oral Explanation</li> <li>• Mental calculation</li> <li>• Self-reflection/time management techniques</li> </ul>
<b>Inquiry Research Mode</b> <ul style="list-style-type: none"> <li>• Research Process</li> <li>• Dialogues with Teacher &amp; Peers</li> <li>• Mathematical problem solving</li> <li>• Inquiry process</li> <li>• Scientific method</li> </ul>		

## Strategies for Assessment & Evaluation of Student Performance

Insight Academy of Canada's (IAC) Assessment and Evaluation policy is aligned with the Ministry of Education's Growing Success policy document which outlines the assessment, evaluation, and reporting policies and practices in Ontario schools.

### Basic Considerations

The primary purpose of assessment and evaluation is to improve student learning. Assessment is the process of gathering information from a variety of sources that accurately reflects how well a student is achieving the curriculum expectations in a course. Evaluation refers to the process of judging the quality of student learning on the basis of established performance standards, and assigning a value to represent that quality.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, IAC teachers will use assessment and evaluation strategies that:

- are fair, transparent, and equitable for all students;
- support all students, including those with special education needs, those who are learning the language of instruction (English or French), and those who are First Nation, Métis, or Inuit;

- are carefully planned to relate to the curriculum expectations and learning goals and, as much as possible, to the interests, learning styles and preferences, needs, and experiences of all students;
- are communicated clearly to students and parents at the beginning of the school year or course and at other appropriate points throughout the school year or course;
- are ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning;
- provide ongoing descriptive feedback that is clear, specific, meaningful, and timely to support improved learning and achievement;
- develop students' self-assessment skills to enable them to assess their own learning, set specific goals, and plan next steps for their learning

## Evaluation and Reporting of Student Achievement

Insight Academy of Canada's (IAC) will use the Provincial Report Card, Grades 9–12, for formal written reports to students and parents two times a term. The report card provides a record of the student's achievement of the curriculum expectations in the course, at particular points in the school year or term, in the form of a percentage grade. The percentage grade represents the quality of the student's overall achievement of the expectations for the course and reflects the corresponding level of achievement as described in the achievement chart for the discipline.

A final grade is recorded for the course, and a credit is granted and recorded for the course in which the student's grade is 50% or higher. The final grade for the course will be determined as follows:

- Seventy per cent of the grade will be based on evaluations conducted throughout the course. This portion of the grade will reflect the student's most consistent level of achievement throughout the course, although special consideration will be given to more recent evidence of achievement.
- Thirty per cent of the grade will be based on a final evaluation in the form of an examination and administered at the end of the course.

Assessment and Evaluation Categories and Weights			
Achievement Categories	Percent	Evaluation for Final Grade	Percent
Knowledge/Understanding	25%	Term Work	70%
Inquiry/Thinking	25%		
Communication	25%	Final Evaluation	30%
Application	25%		

## Reporting on Demonstrated Learning Skills & Work Habits

The report card provides a record of the learning skills demonstrated by the student in every course, in the following six categories: Responsibility, Organization, Independent Work, Collaboration, Initiative & Self-regulation. These learning skills and work habits are evaluated using a four-point scale (E-Excellent, G-Good, S-Satisfactory, N-Needs Improvement). The separate evaluation and reporting of the learning skills and work habits in these six areas reflect their critical role in students' achievement of the curriculum expectations. To the extent possible, the evaluation of learning skills

and work habits, apart from any that may be included as part of a curriculum expectation in a course, should not be considered in the determination of percentage grades.

In order to ensure that assessment and evaluation are valid and reliable, and that they lead to the improvement of student learning, I.A.C teachers use a variety of strategies throughout the course.

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