NIAGARA ACADEMY

COURSE OUTLINE

COURSE:	Physics Grade 12, University Preparation (SPH4U)
SCHOOL:	Niagara Academy
DEVELOPED BY:	A. Cuthbertson, September, 2008, M. Richter, 2015, 2016, 2017
COURSE TITLE:	Physics
COURSE TYPE:	University Preparation
COURSE GRADE:	Twelve
COURSE CODE:	SPH4U
DEVELOPED FROM:	The Ontario Curriculum Grades 11 and 12, Science, 2008 http://www.edu.gov.on.ca/eng/curriculum/secondary/2009science11_12.pdf
PREREQUISITE:	Physics, Grade 11, University Preparation
COURSE DURATION	110 hours
CREDIT VALUE:	1.0
TEXT:	Nelson Physics 12, Thomson Nelson, 2003

COURSE DESCRIPTION AND RATIONALE

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 analyse, 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 EXPECTATIONS

A.	***Scientific Investigation Skills and Career Exploration*** 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.	***Dynamics*** By the end of 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 work, energy, momentum, and the laws of conservation of energy and conservation of momentum, in one and two dimensions.

C.	***Energy and Momentum*** By the end of 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 the relationship between changes in velocity and unbalanced forces in one dimension.

D.	***Gravitational, Electric and Magnetic Fields*** By the end of 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.

E.	***The Wave Nature of Light*** By the end of 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.

ASSESSMENT AND EVALUATION

Evaluation and Reporting of Student Achievement
Student achievement is communicated formally to students and parents by means of the Provincial Report Card, Grades 9–12. The report card provides a record of the student's achievement of the curriculum expectations in every course, at particular points in the school year or semester, 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 which are described in the achievement chart on pages 26-27 of The Ontario Curriculum Grades 11 and 12, Science, 2008, Website: http:// www.edu.gov.on.ca/eng/curriculum/secondary/2009science11_12.pdf

Learning Skills will also be assessed and reported on the Provincial Report Card, Grades 9-12. The quality of the learning skills demonstrated by a student are recorded in six categories – Responsibility, Organization, Independent Work, Collaboration, Initiative, Self-Regulation – are assessed throughout the semester using a four-point scale (E- Excellent, G-Good, S- Satisfactory, N- Needs Improvement), and the document page 11, Growing Success: Assessment, Evaluation and Reporting in Ontario Schools, 2010, as a guide (http://www.edu.gov.on.ca/eng/policyfunding/growSuccess.pdf).

Assessment for Learning will be used as a process for seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go, and how best to get there. Teachers will use diagnostic assessment before instruction and formative assessment will occur frequently and in an ongoing manner to monitor students' progress. Observation and conversation will be used to determine the needs of individual student learning.

Assessment as Learning will focus on the explicit fostering of student's capacity over time to be their own best assessors, but teachers need to start by presenting and modelling external, structured opportunities for students to assess themselves. Formative assessment be used by students to monitor their own and their peers' progress.
Assessment of Learning will be used as the assessment that becomes public and results in statements or symbols about how well students are learning. Summative assessment will be used by the teacher to summarize learning at a given point in time. (Ref: page 31 of Growing Success)

The teacher will use assessment strategies that:
- are fair, transparent and equitable for all students;

- are clearly communicated to students at the beginning of the course and at other points throughout the semester
- are varied in nature, administered over a period of time and designed to provide opportunities for students to demonstrated the full range of their learning
- are appropriate for the learning activities used, the purposes of instruction and the needs and experiences of the students
- 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
- accommodate students with special education needs, consistent with the strategies outlined in their Individual Education Plan
- accommodate the needs of students who are learning the language of instruction
- ensure that each student is given clear directions for improvement
- promote students' ability to assess their own learning and to set specific goals
- ensure that each student is given clear directions for improvement

A final grade for this course will be recorded on the report and a credit is granted if the student's grade is 50% or higher. The final grade for this 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 should reflect the student's most consistent level of achievement throughout the course, although special consideration should be given to more recent evidence of achievement. Please see the following page for an explanation of how course work marks will be obtained.
- Thirty per cent of the grade will be based on a final evaluation in the form of an examination, performance task and/or other method of evaluation suitable to the course content and administered towards the end of the course. This final evaluation will include a Culminating Activity 10% and a Final Exam 20%.
- A student's achievement of the overall curriculum expectations will be evaluated in accordance with the achievement charts in the provincial curriculum and will be reported using percentage marks. It is expected that both mathematical calculations and professional judgement will inform the determination of percentage marks.

COURSE CONTENT AND EVALUATION

Evaluation in each unit will include Knowledge/Understanding - 25%, Thinking - 25%, Communication - 25%, Application - 25%. Examples of term work to be assessed are notebooks, lab activities, reflections/journals, presentations, case studies, discussions, search/graphing/model creating/investigative assignments, reports, performance tasks, quizzes, unit tests.

Unit	Unit Description	Term Work	Hours
Unit One	**SCIENTIFIC INVESTIGATION SKILLS AND CAREER EXPLORATION**		
	1. Formulate relevant scientific questions about observed relationships, ideas, problems, or issues, make informed predictions, and/or formulate educated hypotheses to focus inquiries or research.	6%	12 hrs
	2. Identify and describe a variety of careers related to the fields of science under study (e.g., hydro meter reader, hospitality employee, waste management operator, custodian) and the education and training necessary for these careers.		
	3. Describe the contributions of scientists, including Canadians (e.g., Mark Schacter, Sheila Watt-Cloutier, Marlo Reynolds, J. Ross MacKay, Linda Duncan), to the fields under study.		
Unit Two	**MOTION AND FORCES: DYNAMICS**		
	1. Kinematics: Speed and velocity, acceleration, projectile motion	12.8%	24.5 hrs
	2. Dynamics: Forces and free-body diagrams, Newton's Law of Motion, frictional forces, inertial and non-inertial frames of reference, static equilibrium forces		
	3. Circular Motion: Uniform circular motion, universal gravitation, satellites and space stations, simulating artificial gravity		
Unit Three	**FORCES**		
	1. Work and energy: work done by a constant force, kinetic energy and the work-energy theorem, gravitational potential energy at Earth's surface, law of Conservation of Energy, elastic potential energy and simple harmonic motion	12.8%	24.5 hrs
	2. Momentum and collisions: momentum and impulse, conservation of momentum in one dimension, elastic and inelastic collisions, conservation of momentum in two dimensions		
	3. Gravitation and celestial mechanics: gravitational fields, Orbits and Kepler's Laws, gravitational potential energy in general		

Unit Four	**ELECTRIC, GRAVITATIONAL AND MAGNETIC FIELDS**		
	1. Electrical charges and electrical fields: electric charge and the electrical structure of matter, electric force: Coulomb's Law, Electric fields, electric potential, the Millikan Experiment-determining the elementary charge, the motion of charged particles in electric fields, electric force between charges, motion of charged particles in electric fields	12.8%	24.5 hrs
	2. Magnetic fields and electromagnetism: natural magnetism and electromagnetism, magnetic force on moving charges, magnetic force on a conductor, electromagnetic induction		
Unit Five	**THE WAVE NATURE OF LIGHT**		
	1. Waves and light: waves in two dimensions, diffraction of water waves, interference of waves in two dimensions, light-wave or particle?, wave interference-Young's Double-Slit Experiment, colour and wavelength	12.8%	24.5 hrs
	2. Wave effects of light: polarization of light, diffraction of light through a single slit, diffraction gratings, interference in thin films, applications of thin films, holography, Michelson's Interferometer, electromagnetic waves and light, applications of electromagnetic waves		
	TERM WORK TOTALS	70%	110 hrs
Final Evaluation	Culminating activity Final Exam	10% 20%	
	FINAL MARK	100%	

TEACHING AND LEARNING STRATEGIES

Effective instructional approaches and learning activities draw on students' prior knowledge, capture their interest, and encourage meaningful practice both inside and outside the classroom. Students will be engaged when they are able to see the connection between the scientific concepts they are learning and their application in the world around them and in real-life situations. The following are specific strategies for teaching and learning.

- Assessment of prior knowledge and provision of differentiated instruction for individual students
- Teaching and modelling of learning strategies
- Problem posing and problem solving
- Individual and cooperative small group learning, teamwork
- Hands-on experiments
- Brainstorming
- Creation of scenarios for decision making
- Independent research
- Issue-based analysis
- Personal reflection

- Seminar presentations
- Use of technology
- Hands-on applications
- Constructive or creative dialogue

CONSIDERATIONS FOR PROGRAM PLANNING

The planning and administering of this course is based on the premise that all students can be successful language learners. The teacher will provide quality instruction that respects students' strengths and address their learning needs, using assessment information to plan instruction.
Teachers of science will incorporate appropriate strategies for instruction and assessment to facilitate the success of the ELL students in their classrooms. These strategies include:

- modification of some or all of the course expectations, based on the student's level of English proficiency;
- use of a variety of instructional strategies (e.g. extensive use of visual cues, manipulatives, pictures, diagrams, graphic organizers; attention to clarity of instructions; modelling of preferred ways of working in mathematics; previewing of textbooks; pre-teaching of key specialized vocabulary; encouragement of peer tutoring and class discussion; strategic use of students' first languages);
- use of a variety of learning resources (e.g., visual material, simplified text, bilingual dictionaries, culturally diverse materials);
- use of assessment accommodations (e.g., granting of extra time; use of alternative forms of assessment, such as oral interviews, learning logs, or portfolios; simplification of language used in problems and instructions).

Information and communications technology will be used throughout the course where it is appropriate. The program will also include opportunities for students to apply their language skills to work-related situations, to explore educational and career options, and to become self-directed learners.