

Curriculum Correlation Chart

Forces and Motion

Overall Expectations

By the end of this course, students will:

- analyse the motion of objects in horizontal, vertical, and inclined planes, and predict and explain the motion with reference to the forces acting on the objects;
- investigate motion in a plane, through experiments or simulations, and analyse and solve problems involving the forces acting on an object in linear, projectile, and circular motion, with the aid of vectors, graphs, and free-body diagrams;
- analyse ways in which an understanding of the dynamics of motion relates to the development and use of technological devices, including terrestrial and space vehicles, and the enhancement of recreational activities and sports equipment.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

• define and describe the concepts and units related to dynamics (e.g., inertial and non-inertial frames of reference);	Chapter 1
• analyse and predict, in quantitative terms, and explain the linear motion of objects in horizontal, vertical, and inclined planes;	Sections 2.1-2.6
• analyse and predict, in quantitative terms, and explain the motion of a projectile with respect to the horizontal and vertical components of its motion;	Section 2.3
• analyse and predict, in quantitative terms, and explain uniform circular motion in the horizontal and vertical planes with reference to the forces involved;	Sections 2.7, 2.8,
• distinguish between inertial and accelerating (non-inertial) frames of reference, and predict velocity and acceleration in a variety of situations;	Sections 1.4, 1.5, 1.6, 1.7, 1.8, 1.11
• describe Newton's law of universal gravitation, apply it quantitatively, and use it to explain planetary and satellite motion.	Sections 1.15, 2.8

Developing Skills of Inquiry and Communication

By the end of this course, students will:

<ul style="list-style-type: none">analyse experimental data, using vectors, graphs, trigonometry, and the resolution of vectors into perpendicular components, to determine the net force acting on an object and its resulting motion;	Labs 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2
<ul style="list-style-type: none">carry out experiments or simulations involving objects moving in two dimensions, and analyse and display the data in an appropriate form (e.g., investigate the motion of objects on a horizontal or inclined plane; or the motion of projectiles);	Labs 1.1, 1.2, 2.1, 2.2, 2.3, 3.1, 3.2
<ul style="list-style-type: none">predict the motion of an object, and then design and conduct an experiment to test the prediction (e.g., verify predictions for such quantities as the time of flight, range, and maximum height of a projectile);	Lab 2.1, Chapter 1 STSE, Chapter 2 STSE
<ul style="list-style-type: none">investigate, through experimentation, the relationships among centripetal acceleration, radius of orbit, and the period and frequency of an object in uniform circular motion; analyse the relationships in quantitative terms; and display the relationships using a graph.	Lab 2.2

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

<ul style="list-style-type: none">describe, or construct prototypes of, technologies based on the concepts and principles related to projectile and circular motion (e.g., construct a model of an amusement park ride and explain the scientific principles that underlie its design; explain, using scientific concepts and principles, how a centrifuge separates the components of blood);	Lab 2.3
<ul style="list-style-type: none">analyse the principles of dynamics and describe, with reference to these principles, how the motion of human beings, objects, and vehicles can be modified (e.g., analyse the physics of throwing a baseball; analyse the frictional forces acting on objects and explain how the control of these forces has been used to modify the design of objects such as skis and car tires).	Chapter 1 STSE, Chapter 2 STSE

Energy and Momentum

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of the concepts of work, energy, momentum, and the laws of conservation of energy and of momentum for objects moving in two dimensions, and explain them in qualitative and quantitative terms;
- investigate the laws of conservation of momentum and of energy (including elastic and inelastic collisions) through experiments or simulations, and analyse and solve problems involving these laws with the aid of vectors, graphs, and free-body diagrams;
- analyse and describe the application of the concepts of energy and momentum to the design and development of a wide range of collision and impact-absorbing devices used in everyday life.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

<ul style="list-style-type: none">define and describe the concepts and units related to momentum and energy (e.g., momentum, impulse, work-energy theorem, gravitational potential energy, elastic potential energy, thermal energy and its transfer [heat], elastic collision, inelastic collision, open and closed energy systems, simple harmonic motion);	Chapters 4, 5, 6
<ul style="list-style-type: none">analyse, with the aid of vector diagrams, the linear momentum of a collection of objects, and apply quantitatively the law of conservation of linear momentum;	Chapter 4
<ul style="list-style-type: none">analyse situations involving the concepts of mechanical energy, thermal energy and its transfer (heat), and the laws of conservation of momentum and of energy;	Chapters 4, 5, 6
<ul style="list-style-type: none">distinguish between elastic and inelastic collisions;	Section 5.7
<ul style="list-style-type: none">analyse and explain common situations involving work and energy, using the work-energy theorem;	Chapter 5
<ul style="list-style-type: none">analyse the factors affecting the motion of isolated celestial objects, and calculate the gravitational potential energy for each system, as required;	Sections 6.1, 6.2
<ul style="list-style-type: none">analyse isolated planetary and satellite motion and describe it in terms of the forms of energy and energy transformations that occur (e.g., calculate the energy required to propel a spaceship from the Earth's surface out of the Earth's gravitational field, and describe the energy transformations that take place; calculate the kinetic and gravitational potential energy of a satellite that is in a stable circular orbit around a planet);	Sections 6.1, 6.2
<ul style="list-style-type: none">state Hooke's law and analyse it in quantitative terms.	Section 5.5

Developing Skills of Inquiry and Communication

By the end of this course, students will:

<ul style="list-style-type: none">investigate the laws of conservation of momentum and of energy in one and two dimensions by carrying out experiments or simulations and the necessary analytical procedures (e.g., use vector diagrams to determine whether the collisions of pucks on an air table are elastic or inelastic);	Labs 4.1, 4.2, 4.3, 5.1
<ul style="list-style-type: none">design and conduct an experiment to verify the conservation of energy in a system involving kinetic energy, thermal energy and its transfer (heat), and gravitational and elastic potential energy (e.g., design and conduct an experiment to verify Hooke's law; develop criteria to specify the design, and analyse the effectiveness, through experimentation, of an "egg-drop" container).	Labs 5.2, 5.3, 5.4

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

<ul style="list-style-type: none">analyse and describe, using the concepts and laws of energy and of momentum, practical applications of energy transformations and momentum conservation (e.g., analyse and describe the operation of a shock absorber, and outline the energy transformations that take place; analyse and explain, using scientific concepts and principles, the design of protective equipment developed for recreational and sports activities; research and explain the workings of a clock);	Sections 5.7, 6.4
<ul style="list-style-type: none">identify and analyse social issues that relate to the development of vehicles	Section 5.7, Section 3.7

Electric, Gravitational, and Magnetic Fields

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of the concepts, principles, and laws related to electric, gravitational, and magnetic forces and fields, and explain them in qualitative and quantitative terms;
- conduct investigations and analyse and solve problems related to electric, gravitational, and magnetic fields;
- explain the roles of evidence and theories in the development of scientific knowledge related to electric, gravitational, and magnetic fields, and evaluate and describe the social and economic impact of technological developments related to the concept of fields.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

<ul style="list-style-type: none">define and describe the concepts and units related to electric, gravitational, and magnetic fields	Chapters 8, 9
<ul style="list-style-type: none">state Coulomb's law and Newton's law of universal gravitation, and analyse and compare them in qualitative terms;	Section 8.4
<ul style="list-style-type: none">apply Coulomb's law and Newton's law of universal gravitation quantitatively in specific contexts;	Section 8.6
<ul style="list-style-type: none">compare the properties of electric, gravitational, and magnetic fields by describing and illustrating the source and direction of the field in each case;	Section 8.5, 9.1, 9.3
<ul style="list-style-type: none">apply quantitatively the concept of electric potential energy in a variety of contexts, and compare the characteristics of electric potential energy with those of gravitational potential energy;	Sections 8.7, 8.8, 8.9
<ul style="list-style-type: none">analyse in quantitative terms, and illustrate using field and vector diagrams, the electric field and the electric forces produced by a single point charge, two point charges, and two oppositely charged parallel plates	Sections 8.4, 8.5, 8.8, 8.9
<ul style="list-style-type: none">describe and explain, in qualitative terms, the electric field that exists inside and on the surface of a charged conductor (e.g., inside and around a coaxial cable);	Section 8.5
<ul style="list-style-type: none">predict the forces acting on a moving charge and on a current-carrying conductor in a uniform magnetic field.	Sections 9.3, 9.4, 9.5, 9.6, 9.7

Developing Skills of Inquiry and Communication

By the end of this course, students will:

<ul style="list-style-type: none">determine the net force on, and resulting motion of, objects and charged particles by collecting, analysing, and interpreting quantitative data from experiments or computer simulations involving electric, gravitational, and magnetic fields (e.g., calculate the charge on an electron, using experimentally collected data; conduct an experiment to verify Coulomb's law and analyse discrepancies between theoretical and empirical values);	Labs 8.1, 9.1
<ul style="list-style-type: none">analyse and explain the properties of electric fields and demonstrate how an understanding of these properties can be applied to control or alter the electric field around a conductor (e.g., demonstrate how shielding on electronic equipment or on connecting conductors [coaxial cables] affects electric and magnetic fields).	Lab 8.2

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

<ul style="list-style-type: none">explain how the concept of a field developed into a general scientific model, and describe how it affected scientific thinking (e.g., explain how field theory helped scientists understand, on a macro scale, the motion of celestial bodies and, on a micro scale, the motion of particles in electromagnetic fields);	Sections 8.5, 8.6, 9.7
<ul style="list-style-type: none">describe instances where developments in technology resulted in the advancement or revision of scientific theories, and analyse the principles involved in these discoveries and theories (e.g., analyse the operation of particle accelerators, and describe how data obtained through their use led to enhanced scientific models of elementary particles);	Sections 9.3, 9.4, 9.6, 9.7
<ul style="list-style-type: none">evaluate, using their own criteria, the social and economic impact of new technologies based on a scientific understanding of electric, gravitational, and magnetic fields.	Chapter 9 STSE

The Wave Nature of Light

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of the wave model of electromagnetic radiation, and describe how it explains diffraction patterns, interference, and polarization;
- perform experiments relating the wave model of light and technical applications of electromagnetic radiation (e.g., lasers and fibre optics) to the phenomena of refraction, diffraction, interference, and polarization;
- analyse phenomena involving light and colour, explain them in terms of the wave model of light, and explain how this model provides a basis for developing technological devices.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

<ul style="list-style-type: none">define and explain the concepts and units related to the wave nature of light (e.g., diffraction, dispersion, wave interference, polarization, electromagnetic radiation, electromagnetic spectrum);	Chapters 10, 11
<ul style="list-style-type: none">describe, citing examples, how electromagnetic radiation, as a form of energy, is produced and transmitted, and how it interacts with matter;	Chapters 10, 11
<ul style="list-style-type: none">describe the phenomenon of wave interference as it applies to light in qualitative and quantitative terms, using diagrams and sketches;	Sections 11.2, 11.3, 11.4, 11.5, 11.6
<ul style="list-style-type: none">describe and explain the phenomenon of wave diffraction as it applies to light in quantitative terms, using diagrams;	Sections 11.7, 11.8, 11.9, 11.10
<ul style="list-style-type: none">describe and explain the experimental evidence supporting a wave model of light (e.g., describe the scientific principles related to Young's double-slit experiment and explain how his results led to a general acceptance of the wave model of light).	Sections 11.4, 11.7

Developing Skills of Inquiry and Communication

By the end of this course, students will:

<ul style="list-style-type: none">identify the theoretical basis of an investigation, and develop a prediction that is consistent with that theoretical basis (e.g., predict diffraction and interference patterns produced in ripple tanks; predict the diffraction pattern produced when a human hair is passed in front of a laser beam; predict effects related to the polarization of light as it passes through two polarizing filters);	Labs 10.2, 10.3, 11.1
<ul style="list-style-type: none">identify the interference pattern produced by the diffraction of light through narrow slits (single and double slits) and diffraction gratings, and analyse it in qualitative and quantitative terms;	Lab 11.4
<ul style="list-style-type: none">collect and interpret experimental data in support of a scientific theory (e.g., conduct an experiment to observe the interference pattern produced by a light source shining through a double slit and explain how the data supports the wave theory of light);	Lab 11.2
<ul style="list-style-type: none">analyse and interpret experimental evidence indicating that light has some characteristics and properties that are similar to those of mechanical waves and sound.	Lab 11.3

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

<ul style="list-style-type: none">describe instances where the development of new technologies resulted in the advancement or revision of scientific theories (e.g., outline the scientific understandings that were made possible through the use of such devices as the electron microscope and interferometers);	Sections 10.3, 11.5, 11.10, 13.2
<ul style="list-style-type: none">describe and explain the design and operation of technologies related to electromagnetic radiation (e.g., describe the scientific principles that underlie Polaroid filters for enhancing photographic images; describe how information is stored and retrieved using compact discs and laser beams);	Sections 10.6, 11.5, Chapter 11 STSE
<ul style="list-style-type: none">analyse, using the concepts of refraction, diffraction, and wave interference, the separation of light into colours in various phenomena (e.g., the colours produced by thin films), which forms the basis for the design of technological devices (e.g., the grating spectroscope).	Sections 10.4, 11.2, 11.3, 11.4, 11.5, 11.6, 11.8, 11.9, 11.10

Matter-Energy Interface

Overall Expectations

By the end of this course, students will:

- demonstrate an understanding of the basic concepts of Einstein's special theory of relativity and of the development of models of matter, based on classical and early quantum mechanics, that involve an interface between matter and energy;
- interpret data to support scientific models of matter, and conduct thought experiments as a way of exploring abstract scientific ideas;
- describe how the introduction of new conceptual models and theories can influence and change scientific thought and lead to the development of new technologies.

Specific Expectations

Understanding Basic Concepts

By the end of this course, students will:

<ul style="list-style-type: none">define and describe the concepts and units related to the present-day understanding of the nature of the atom and elementary particles (e.g., radioactivity, quantum theory, photoelectric effect, matter waves, mass-energy equivalence);	Chapters 12, 13, 14
<ul style="list-style-type: none">describe the principal forms of nuclear decay and compare the properties of alpha particles, beta particles, and gamma rays in terms of mass, charge, speed, penetrating power, and ionizing ability;	Section 14.2
<ul style="list-style-type: none">describe the photoelectric effect in terms of the quantum energy concept, and outline the experimental evidence that supports a particle model of light;	Section 12.3
<ul style="list-style-type: none">describe and explain in qualitative terms the Bohr model of the (hydrogen) atom as a synthesis of classical and early quantum mechanics;	Section 12.6

<ul style="list-style-type: none"> state Einstein's two postulates for the special theory of relativity and describe related thought experiments (e.g., describe Einstein's thought experiments relating to the constancy of the speed of light in all inertial frames of reference, time dilation, and length contraction); 	Sections 13.1, 13.2, 13.3, 13.4, 13.5, 13.6
<ul style="list-style-type: none"> apply quantitatively the laws of conservation of mass and energy, using Einstein's mass-energy equivalence; 	Section 13.7
<ul style="list-style-type: none"> describe the Standard Model of elementary particles in terms of the characteristic properties of quarks, leptons, and bosons, and identify the quarks that form familiar particles such as the proton and neutron. 	Sections 14.7, 14.8

Developing Skills of Inquiry and Communication

By the end of this course, students will:

<ul style="list-style-type: none"> collect and interpret experimental data in support of a scientific theory (e.g., conduct an experiment, or view prepared slides, to analyse how the emission spectrum of hydrogen supports Bohr's predicted transition states in his model of the atom); 	Labs 12.1, 12.2, 12.3
<ul style="list-style-type: none"> conduct thought experiments as a way of developing an abstract understanding of the physical world (e.g., outline the sequence of thoughts used to predict effects arising from time dilation, length contraction, and increase of mass when an object travels at several different velocities, including those that approach the speed of light); 	Lab 13.1
<ul style="list-style-type: none"> analyse images of the trajectories of elementary particles to determine the mass-versus-charge ratio; 	Sections 14.2, 14.7, 14.8
<ul style="list-style-type: none"> compile, organize, and display data related to the nature of the atom and elementary particles, using appropriate formats and treatments (e.g., using experimental data or simulations, determine and display the half-lives for radioactive decay of isotopes used in carbon dating or in medical treatments). 	Chapter 14 STSE, Lab 14.1

Relating Science to Technology, Society, and the Environment

By the end of this course, students will:

<ul style="list-style-type: none"> outline the historical development of scientific views and models of matter and energy, from Bohr's model of the hydrogen atom to present-day theories of atomic structure (e.g., construct a concept map of scientific ideas that have been developed since Bohr's model, and outline how these ideas are synthesized in the Standard Model); 	Sections 14.7, 14.8
<ul style="list-style-type: none"> describe how the development of the quantum theory has led to scientific and technological advances that have benefited society (e.g., describe the scientific principles related to, and the function of, lasers, the electron microscope, or solid state electronic components); 	Chapter 12 STSE, Chapter 13 STSE, Chapter 14 STSE
<ul style="list-style-type: none"> describe examples of Canadian contributions to modern physics 	Section 14.8