Please note that curriculum connections match general topics covered in this program. Some curriculum connections may not be covered, since programs vary due to student questions, program length, and customized elements. Please contact us with any specific questions or ideas.

Universe - Learning Skills and Curriculum Connections:

Grade 11 Curriculum Expectations:
*Note Grade 11 expectations listed are for the Physics Course SPH3U

A1.1: formulate relevant scientific questions about observed relationships, ideas, problems, or issues, make informed predictions, and/or formulate educated hypotheses to focus inquiries or research

B1.2: assess the impact on society and the environment of a technology that applies concepts related to kinematics (e.g., photo radar helps prevent vehicular accidents and reduces fuel consumption associated with excessive speeding)

Grade 12 Curriculum Expectations:
*Note Grade 12 expectation listed are either from Physics (SPH4U) or Earth and Space Science (SES4U)

Physics SPH4U:

A1.1: formulate relevant scientific questions about observed relationships, ideas, problems, or issues, make informed predictions, and/or formulate educated hypotheses to focus inquiries or research

C3.4: explain the implications of the laws of conservation of energy and conservation of momentum with reference to mechanical systems (e.g., damped harmonic motion in shock absorbers, the impossibility of developing a perpetual motion machine)

D3.1: identify, and compare the properties of, fundamental forces that are associated with different theories and models of physics (e.g., the theory of general relativity and the standard model of particle physics)

E3.3: use the concepts of refraction, diffraction, polarization, and wave interference to explain the separation of light into colours in various situations (e.g., light travelling through a prism; light contacting thin film, soap film, stressed plastic between two polarizing filters)

F2.3: solve problems related to Einstein's theory of special relativity in order to calculate the effects of relativistic motion on time, length, and mass (e.g., the half-life of cosmic ray muons, how far into the future a fast space ship would travel, the magnetic field strength necessary to keep protons in the Large Hadron Collider)
F3.4: describe the standard model of elementary particles in terms of the characteristics of quarks, hadrons, and field particles

Earth and Space Science SES4U:

A1.1: formulate relevant scientific questions about observed relationships, ideas, problems, or issues, make informed predictions, and/or formulate educated hypotheses to focus inquiries or research
A2.1: identify and describe a variety of careers related to the field of science under study (e.g., astronomer, paleontologist, astrophysicist, geologist, professor, planetarium curator) and the education and training necessary for these careers

B1.1: analyse a major milestone in astronomical knowledge or theory (e.g., the discovery of the red shift in the spectra of galaxies; the knowledge gathered from the particle accelerator experiments at CERN in Switzerland), and explain how it revolutionized thinking in the scientific community
B1.2: analyse why and how a particular technology related to astronomical research was developed and how it has been improved over time (e.g., the evolution from optical to radio telescopes and to the Hubble telescope)

B2.2: locate observable features of the night sky using star charts, computer models, or direct observation, and record the location of these features using astronomical terms (e.g., celestial equator, ecliptic) and systems (e.g., altitude and azimuth, right ascension and declination)
B2.3: analyse spectroscopic data mathematically or graphically to determine various properties of stars (e.g., determine surface temperature from peak wavelength using Wein's law; predict chemical composition from spectral absorption lines; determine motion using the Doppler effect)

B2.4: use the Hertzsprung-Russell diagram to determine the interrelationships between the properties of stars (e.g., between mass and luminosity, between colour and luminosity) and to investigate their evolutionary pathways
B2.5: investigate, in quantitative terms, properties of stars, including their distance from Earth (using the parallax method), surface temperature, absolute magnitude, and luminosity
B2.6: investigate, using photographs or diagrams, the basic features of different types of galaxies (e.g., elliptical, spiral, barred spiral, irregular, peculiar), including the Milky Way

B3.1: describe the theoretical and evidential underpinnings of the big bang theory (e.g., the theory that cosmic microwave background radiation is an echo of the big bang; physical evidence of the mass of the universe, and the relationship between mass and gravity) and their implications for the evolution of the universe
B3.2: explain the scale of distances between celestial bodies (e.g., with reference to astronomical units, light years, and parsecs) and the methods astronomers use to determine these distances (e.g., stellar parallax, cepheid variables)
B3.3: describe the characteristics of electromagnetic radiation (e.g., the relationship between wavelength, frequency, and energy) and the ways in which each region of the electromagnetic spectrum is used in making astronomical observations (e.g., X-rays in the search for black holes; infrared radiation to see through interstellar dust)
B3.4: explain how stars are classified on the basis of their surface temperature, luminosity, and chemical composition
B3.5: explain, with reference to a specific star (e.g., Rigel, Sirius, Arcturus), how astronomers use techniques to determine the properties of stars (e.g., mass, diameter, magnitude, temperature, luminosity)
B3.6: describe the sequence of events in the life cycle of a star, from its formation to the main sequence phase and beyond, with specific reference to energy sources and forces involved
B3.7: explain the relationship between the type of death of a star and the star's initial mass (e.g., a star with a low mass will form a planetary nebula and a white dwarf)

C1.2: analyse, on the basis of research, a specific technology that is used in space exploration and that has applications in other areas of research or in the environmental sector (e.g., Canadian satellites and robotics, spacecraft technologies, ground base and orbital telescopes, devices to mitigate the effects of the space environment on living organisms)

C2.1: use appropriate terminology related to planetary science, including, but not limited to: solar system, geocentric, heliocentric, geodesy, geosynchronous, eccentricity, apogee, aphelion, perigee, and perihelion
C2.2: identify geological features and processes that are common to Earth and other bodies in the solar system (e.g., craters, faults, volcanic eruptions), and create a model or illustration to show these features, using data and images from satellites and space probes
C2.3: use an inquiry or research process to investigate the effects of various forms of radiation and high-energy particles on bodies, organisms, and devices within the solar system (e.g., the effects of cosmic rays on atmospheric phenomena, of ultraviolet light on human and animal eyes and skin, of solar wind on radio communications)

C2.4: investigate the ways in which interactions between solid bodies have helped to shape the solar system, including Earth (e.g., the accretion of minor bodies, the formation of moons, the formation of planetary rings)
C2.5: investigate the properties of Earth that protect life from hazards such as radiation and collision with other bodies (e.g., Earth's orbital position helps protect it from asteroids, some of which are deflected by the Jovian planets; Earth's magnetic field protects the planet from solar wind; atmospheric ozone minimizes incoming ultraviolet radiation)
C2.6: investigate techniques used to study and understand objects in the solar system (e.g., the measurement of gravitational pull on space probes to determine the mass of an object, the use of spectroscopy to study atmospheric compositions, the use of the global positioning system to track plate movement and tectonic activity from space)

C3.1: explain the composition of the solar system (e.g., the sun, terrestrial inner planets, the asteroid belt, gas giant outer planets, the Kuiper belt, the scattered disc, the heliopause, the Oort cloud), and describe the characteristics of each component
C3.2: identify and explain the classes of objects orbiting the sun (e.g., planets, dwarf planets, small solar system bodies [SSSBs])
C3.3: explain the formation of the solar system with reference to the fundamental forces and processes involved (e.g., how gravitational force led to the contraction of the original solar nebula)
C3.4: identify the factors that determined the properties of bodies in the solar system (e.g., differences in distance from the sun result in temperature variations that determine whether substances on a planet, moon, or other body are solid or gaseous)
C3.5: identify and explain the properties of celestial bodies within or beyond the solar system, other than Earth, that might support the existence of life (e.g., the possible existence of liquid water on Europa; the proximity of a body to its host star)
C3.6: compare Earth with other objects in the solar system with respect to properties such as mass, size, composition, rotation, magnetic field, and gravitational field
C3.7: identify Kepler's laws, and use them to describe planetary motions (e.g., the shape of their orbits; differences in their orbital velocity)
C3.8: identify Newton's laws, and use them to explain planetary motion
C3.9: describe the major external processes and phenomena that affect Earth (e.g., radiation and particles from the "quiet" and "active" sun; cosmic rays; gravity of the sun and moon; asteroidal and cometary debris, including their force, energy, and matter)