Geoscience Knowledge and Experience Requirements for Professional Registration in Canada

GEOSCIENTISTS GÉOSCIENTIFIQUES CANADA®

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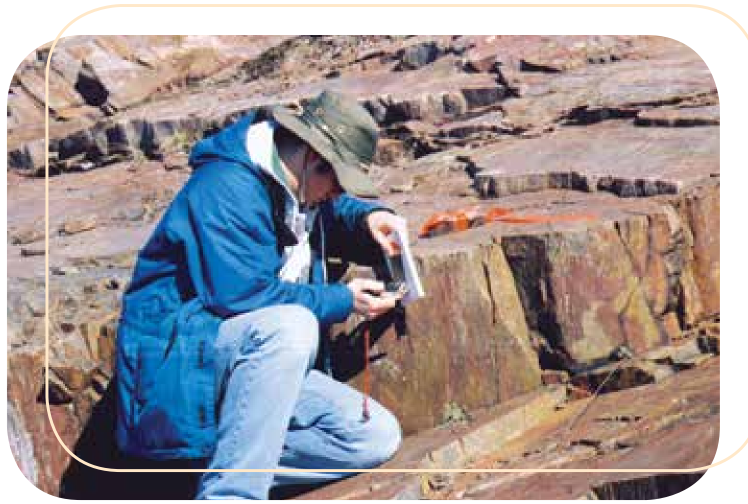
1 Preamble

The practice of professional geoscience is regulated in most Canadian provinces and territories. Legislative acts restrict geoscience practice to individuals who are registered with (and therefore on the "register" and licensed by) the self-regulating professional association in Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland and Labrador, Northwest Territories, Nova Scotia, Nunavut, Ontario, Québec and Saskatchewan. The self-regulating professional associations are referred to in this document as the "regulators." Geoscience is not currently regulated in Prince Edward Island or Yukon.

Geoscientists Canada (formerly Canadian Council of Professional Geoscientists) is the national consortium of the regulators that govern geoscience practice in the provinces and territories of Canada.



The Canadian Geoscience Standards Board (CGSB) is a committee created by the Geoscientists Canada with representation from the regulators, mandated to assist the Geoscientists Canada in developing appropriate and mutually agreed-upon requirements for professional registration in Canada.

In the fulfillment of its mandate, the CGSB produced for Geoscientists Canada this document entitled "Geoscience Knowledge and Experience Requirements for Professional Registration in Canada" as a common reference for the regulators.

This document also provides a reference for geoscience students, geoscience educators and career guidance counselors, and others among the public who may require general information on professional registration in Canada.

This document is a summary of what has been agreed to across the profession and among the regulators within Canada, concerning requirements for new applicants seeking registration in any one of the provinces or territories for the first time. Existing registrants in any province or territory seeking transfer to another should refer to the regulator in the province or territory of destination.

It must be emphasized that this document is a summary only and that requirements for registration are set out under the legislative act in each province or territory. Therefore, it cannot cover all aspects of registration in depth, nor does it describe differences in requirements that may exist.

For specific information on requirements for registration, please consult the regulator in the province or territory of interest. The back cover of this document contains a list of the regulator in each province and territory, together with the web site address for each.

1.1 *Background to this Document*

The first effort at defining common requirements for licensure of geoscientists was undertaken in the late 1990s and released in 2000 as a Geoscientists Canada document entitled *"Recommended Minimum Requirements of Geoscience Knowledge and Work Experience for Professional Practice."*

The CGSB, as part of its mandate, is required to review Geoscientists Canada's documentation on registration requirements every five years and to advise the Geoscientists Canada on suitable revisions and modifications. The most recent review process began in 2005 and has culminated in this replacement document.

IMPORTANT NOTE: While the contents have been approved by Geoscientists Canada and recommended for use by the regulators, this document is not legally binding upon any regulator. Each regulator is an independent body established under its own legislative act and with the obligation to set its own requirements for registration and with the authority to make final decisions on all acceptances of applicants for registration and the issuance of licenses to practice in its jurisdiction.

1.2 *Regulation of the Profession and Legal Framework*

Registration as a professional geoscientist is required to practice geoscience in 11 provinces and territories in Canada. By law, practice is restricted to those persons who are registered with the appropriate regulator, such that their names appear on the official register of professionals licensed to practice in that particular province or territory.

The requirements for registration as a professional geoscientist are similar in each province and territory in Canada, but they are not identical.

For example, certain regulators issue distinct professional licenses for the specific geoscience sub-disciplines of geology and geophysics. However, most regulators issue one general license that allows individuals to practice professional geoscience within their own area of competence.

Geoscientists should refer directly to the regulator in the province or territory where they intend to practice to obtain specific information on registration in that jurisdiction.

1.3 *Practice of Professional Geoscience*

Activities that constitute the practice of professional geoscience are defined in the legislative acts that govern the profession in each of the provinces and territories in Canada where registration applies. The definitions of practice are generally similar in each of the provinces and territories, but some minor differences do exist. The texts of the legislative acts or other statutes that contain each definition may be obtained from the appropriate regulator.

A general model definition of the practice of professional geoscience developed by Geoscientists Canada and reflecting a consensus of views is as follows:

The practice of professional geoscience means the performing of any activity that requires application of the principles of the geological sciences, and that concerns the safeguarding of public welfare, life, health, property, or economic interests, including, but not limited to:

a) investigations, interpretations, evaluations, consultations or management aimed at discovery or development of metallic or non-metallic minerals, rocks, nuclear or fossil fuels, precious stones and water resources;

b) investigations, interpretations, evaluations, consultations, or management relating to geoscientific properties, conditions or processes that may affect the well-being of the general public, including those pertaining to preservation of the natural environment.

1.4 *Eligibility for Registration*

Becoming a professional geoscientist with the ability to practice without supervision in a competent and ethical manner is a comprehensive career-founding process that involves education in science and geoscience; work experience in the capacity of a geoscientist; and knowledge of legal, professional, and ethical expectations and obligations.

Requirements for registration as a professional geoscientist are typically made up of the following distinct, but interrelated, elements:

- geoscience knowledge, which is typically obtained by completing a bachelor's degree in geoscience;
- geoscience practice experience, which is typically obtained under the supervision of a licensed professional geoscientist;
- good character, reputation and conduct;
- proficiency in the language of business in the province or territory of practice; and
- knowledge of professional practice issues, including law and ethics.

This document sets out requirements for geoscience knowledge and geoscience experience: Good conduct and language proficiency are assessed by each regulator as part of the registration process. Knowledge of professional practice issues, including law and ethics, is assessed through a professional practice and ethics exam, which applicants are expected to sit and pass before they are permitted to practice. Some universities offer courses in professional practice, law and ethics; where available, applicants are encouraged to take such courses.

PREAMBLE

2 Purpose

2.1 *Primary Purpose*

Consensus on requirements for registration across Canada provides the general public, practicing professional geoscientists, and regulators with assurance that professional geoscientists registered anywhere in Canada possess similar capabilities.

Mutually agreed-upon requirements are an effective and efficient means for the regulators to jointly improve criteria for registration of professional geoscientists and ensure that they are current and appropriate as the profession evolves and changes. They also allow for harmonization, over time, of registration practices that may differ.

Mutually agreed-upon requirements also facilitate the mobility of professional geoscientists in Canada under the *Agreement on Internal Trade* and aid in the development of international mutual recognition agreements.

This document is principally designed for use by the regulators – their admissions and registration officials, boards of examiners and registration committees, and panels or tribunals handling registration appeals.

2.2 *Other Purpose*

While this document is primarily intended to serve as a reference for regulators, its other important purpose is to provide information to:

- those studying to enter the profession of geoscience, and those preparing to become registered;
- educators and trainers of geoscientists, including professors and university counselors guiding students, and faculty and departmental staff developing geoscience curricula;
- persons migrating to Canada and internationally mobile professionals intending to practice professionally in Canada;
- law and policy makers, governments and regulators of other professions across Canada, and those involved in the registration and regulation of the geoscience profession outside Canada; and
- employers of geoscientists, the users of the professional services offered by geoscientists, and the general public.

3 Geoscience Knowledge Requirement

The geoscience knowledge requirement for registration as a professional geoscientist is outlined in the tables in Section 3.3.

While students and their advisors may regard the tables as lists of courses to be completed and passed, they are viewed by regulators as the specified areas of geoscience knowledge in which an applicant must demonstrate proficiency in order to become registered.

3.1 *Bachelor of Science, or Equivalent*

The geoscience knowledge requirement is based on a typical Canadian university Bachelor of Science or Baccalaureate Degree (B.Sc.) in Geoscience that in most of Canada is four years long and includes 40 one-semester (13-week) courses or their equivalent. In the province of Québec, the equivalent consists of a pre-university diploma in natural science from a CEGEP followed by a three-year university B.Sc. program that includes 30 one-semester courses or their equivalent.

In a typical Canadian geoscience degree program, 30 courses are in science and the rest are non-science. Of the 30 courses in science, about 20 are required in geoscience and 10 are required in other sciences, including mathematics, physics, and chemistry. This depth in geoscience and breadth in other sciences is consistent across Canada.

The structure of the geoscience knowledge requirements as set out in the tables in Section 3.3 reflects a typical Bachelor of Science or Baccalaureate Degree (B.Sc.) in Geoscience at a Canadian university. However, as applicants for registration may hold degrees other than a degree in geoscience, and because applicants may have been educated outside of Canada, the geoscience knowledge requirement is set out in sufficient detail to allow the outcomes of a degree from any university to be assessed for equivalency.

Applicants are expected by the regulators to provide university transcripts so that their geoscience education can be verified and assessed against the geoscience knowledge requirements.

Some regulators maintain lists of university degree programs in geoscience that the regulator has pre-determined meet the geoscience knowledge requirements.

3.2 *Structure and Definitions*

Because geoscience education in Canada currently falls into three distinct streams – Geology, Environmental Geoscience and Geophysics, the tables in Section 3.3 are set up to reflect these streams. It is also structured this way because some regulators use different approaches in considering applicants from the three streams, while others issue separate licenses for different types of geoscience practice, such as geology or geophysics.

The fundamental unit of geoscience knowledge used in the tables in Section 3.3 is the Educational Unit or "EU." One EU is defined as formal instruction equivalent to a one-semester (13-week) course in a typical Bachelor of Science or Baccalaureate Degree (B.Sc.) in Geoscience at a Canadian university. For example, one EU could consist of three hours of lectures or equivalent per week, with or without a lab component, for 13 weeks. An EU can be considered to be the equivalent of one three-credit-hour course in a 120-credit hour, four-year degree program. The EU, as used here, does not address the manner in which material in each study area is presented in a university program. Its purpose is to provide a quantitative statement about the amount of geoscience instruction expected in each required unit of study.

3.3 *Geoscience Knowledge Requirement Tables*

The geoscience knowledge requirement is set out in three tables, with a separate column in each table for each principal stream in geoscience education. There are five broad groups of knowledge requirements in the three tables as follows:

Table 1 1A - Compulsory Foundation Science
1B - Additional Foundation Science

Table 2 2A - Compulsory Foundation Geoscience
2B - Additional Foundation Geoscience

Table 3 2C - Other Geoscience/Science

The total number of Educational Units (EUs) recommended is 27, consisting of three from Compulsory Foundation Science, six from Additional Foundation Science, four from Compulsory Foundation Geoscience, five from Additional Foundation Geoscience, and nine Other Geoscience/Science.

In the left column of each group, there is a statement describing how EUs should be counted for each of the groups, and there is a statement for each of the three streams in Table 3: 2C – Other Geoscience/Science – that provides guidance on use of the sample lists of units provided.

Detailed knowledge outcomes from each unit of study are not specified, but brief Geoscience Knowledge Unit Descriptors are provided in Section 5 to indicate the general outcomes expected to have been obtained.

No one single EU course can be used to cover more than one requirement.

Table 1

Groups: 1A - Compulsory Foundation Science and 1B - Additional Foundation Science

		Streams		
	Groups	**Geology**	**Environmental Geoscience**	**Geophysics**
1A	**Compulsory Foundation Science*** **(Total 3 EUs - One EU in each area required)** Mathematics, Physics and Chemistry are the foundation sciences on which the principles and processes of geoscience are founded. A strong foundation in these sciences provides the grounding necessary to understand and apply geoscience concepts.	Chemistry Mathematics Physics	Chemistry Mathematics Physics	Chemistry Mathematics Physics
1B	**Additional Foundation Science*** **(Total 6 EUs)** **(6 EUs required, no more than 2 EUs in any one of the six subject areas.)** A strong background in a range of sciences allows the geoscientist to understand how the geosphere interacts with other parts of our world, to communicate and interact with scientists from other disciplines and with other professionals, and to adapt to the many challenges encountered in practice. "Geo" subject areas containing the foundational topics listed in the linked descriptors may be substituted - e.g. Geostatistics for Statistics, etc. * Biology is highly recommended for those in the Environmental Geoscience stream	Biology Chemistry Computer Programming Mathematics Physics Statistics	Biology * Chemistry Computer Programming Mathematics Physics Statistics	Biology Chemistry Computer Programming Mathematics Physics Statistics
	* NOTE – Requirements in this table must be met by EUs at a first year or higher university level course acceptable for credit towards a degree in science, applied science or engineering. Remedial secondary school level courses, such as algebra, chemistry, geometry, physics or trigonometry are not accepted.			

Table 2

Groups: 2A - Compulsory Foundation Geoscience and 2B - Additional Foundation Geoscience

	Groups	**Geology** (Streams)	**Environmental Geoscience** (Streams)	**Geophysics** (Streams)
2A	**Compulsory Foundation Geoscience** **(Total 4EUs)** **(1 EU in each area required).** All geoscientists share common core knowledge around which the profession of geoscience is practiced. These subject areas define the common knowledge base in geoscience required to practice in all three streams of geoscience.	Field Techniques Mineralogy and Petrology Sedimentation and Stratigraphy Structural Geology	Field Techniques Mineralogy and Petrology Sedimentation and Stratigraphy Structural Geology	Field Techniques Mineralogy and Petrology Sedimentation and Stratigraphy Structural Geology
2B	**Additional Foundation Geoscience** **(Total 5 EUs)** **(Total 5 EUs; Geology and Environmental Science require a minimum of 1 and at most 2 from each sub-group, but no more than one in each subject; Geophysics requires 1 EU from 5 of the sub-groups.)** Beyond common foundation science and geoscience knowledge documented above, training in geoscience generally falls into three broad specializations or streams (geology, environmental geoscience and geophysics), that reflect the basis of three broad sub-disciplines of practice in the profession. Each of these sub-disciplines requires a different set of foundational geoscience knowledge.	Geochemistry Geophysics ——— Igneous Petrology Metamorphic Petrology Sedimentary Petrology ——— Sedimentology Glacial Geology or Geomorphology Remote Sensing	Geochemistry Geophysics ——— Hydrogeology or Hydrology Engineering Geology ——— Geomorphology or Soil Science Glacial Geology Remote Sensing	Digital Signal Processing ——— Global Geophysics / Physics of the Earth ——— Seismology/Seismic Methods ——— Exploration Geophysics ——— Radiometrics/Gravity & Magnetics ——— Electrical & Electromagnetic Methods

Table 3

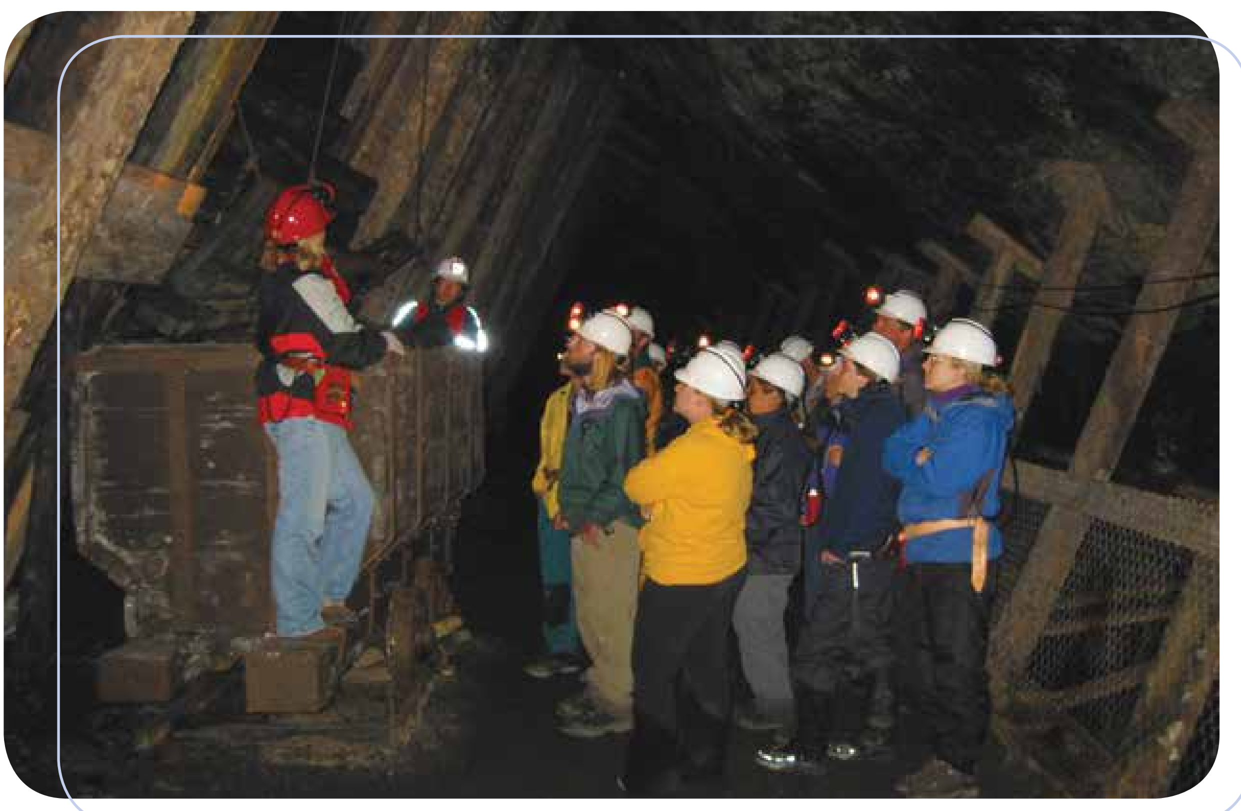
Group: 2C – Other Geoscience (NOTE: These lists are not meant to be exhaustive)				
		Streams		
	Groups	**Geology**	**Environmental Geoscience**	**Geophysics**
2C	**Other Geoscience/Science** **(Minimum Total 9 EUs) (9 EUs must be from the EUs list or must be at a second level or higher acceptable for science credit toward a degree in science, applied science or engineering and relevant to geoscience). Extra courses not used in 2A and 2B can be used in 2C. Advanced courses in these topics can also be used. No one single EU course can be used to cover more than one requirement.** The three broad streams of specialization in geoscience (geology, environmental geoscience and geophysics) embrace distinct knowledge sets that are important to geoscientists in each stream, and collectively comprise the particular knowledge base necessary for proper and appropriate practice.	Within each subject area are listed possible courses that could be used to satisfy the geoscience knowledge requirements. **Communication** Thesis Technical Writing **Earth Systems** Climatology Meteorology Oceanography Earth Systems **Environmental** Hydrogeology Hydrology Environmental Geology Limnogeology Biogeochemistry **Field Techniques** **Geochemistry** Exploration Geochemistry Environmental Geochemistry Isotope Geochemistry Aqueous Geochemistry **Geomorphology** Quaternary Geology Pedology Geomorphology **Geophysics** Physics of the Earth Exploration Geophysics Applied Geophysics Environmental Geophysics **Geotechnical** Natural Hazards Engineering Geology Soil Mechanics Rock Mechanics	Within each subject area are listed possible courses that could be used to satisfy the geoscience knowledge requirements. **Communication** Thesis Technical Writing **Earth Systems** Climatology Meteorology Oceanography Paleoenvironmental Studies Paleoclimatology Paleoecology Paleobiology **Environmental Assessment** **Field Techniques** **Geochemistry** Environmental Geochemistry Isotope Geochemistry Aqueous Geochemistry Biogeochemistry Atmospheric Geochemistry Low temperature Geochemistry **Geomorphology/ Surficial** Geomorphology Natural Hazards Quaternary Geology Pedology Glaciology **Geophysics** Environmental Geophysics Exploration Geophysics Applied Geophysics	Within each subject area are listed possible courses that could be used to satisfy the geoscience knowledge requirements. EUs must be chosen from at least 4 of the boldfaced subject areas below. **Applied Math/ Physics** Calculus Computer-Controlled Instrumentation Condensed Matter Physics Continuum Mechanics Digital Signal Processing Electromagnetic Theory Electronics for Scientists Fluid Dynamics Fluid Flow Porous Media Geostatistics Integral Transforms Linear Algebra Mathematical Physics Numerical Methods/ Computing Optics Partial Differential Equations Signal Analysis Vector and Tensor Analysis **Communication** Thesis Technical Writing **Earth & Planetary Geoscience** Geomagnetism/ Paleomagnetism Global Tectonics Global Geophysics **Field Techniques**

Table 3

Group: 2C – Other Geoscience (NOTE: These lists are not meant to be exhaustive)				
		Streams		
	Groups	**Geology**	**Environmental Geoscience**	**Geophysics**
2C	continued	**Mineralogy** Crystallography X-ray Crystallography Optical Mineralogy Analytical Methods **Paleontology** Micropaleontology Palynology Paleobiology **Petrology** Igneous Petrology Volcanology Metamorphic Petrology Sedimentary Petrology **Quantitative Analysis** Geostatistics Computer Applications in Geoscience Geographic Information Systems **Regional Geology** Geology of Canada Geology of North America **Remote Sensing** Airphoto Interpretation Remote Sensing **Resource Geology** Economic Geology Mineral Deposits Geology Ore Petrology Coal Geology Petroleum Geology Industrial Minerals **Sedimentology** Chemical Sedimentology Clastic Sedimentology Carbonate Sedimentology Glacial Geology	**Geotechnical** Engineering Geology Soil Mechanics Rock Mechanics Resource Geotechnics **Hydrology/ Hydrogeology** Contaminant Transport Hydrogeology Hydrology Fluid Mechanics **Mineralogy/ Petrology** Crystallography X-Ray Crystallography Analytical Methods **Paleontology** Micropaleontology Paleobiology Palynology **Quantitative Analysis** Geostatistics Computer Applications in Geoscience Geographic Information Systems **Regional Geology** Geology of Canada Geology of North America **Remote Sensing** Remote Sensing Airphoto Interpretation **Resource Geology** Economic Geology Mineral Deposits Geology Ore Petrology Coal Geology Petroleum Geology Industrial Minerals	**Fundamental Math/Physics** Complex Analysis Differential Equations Electricity & Magnetism Mechanics Thermodynamics Vibrations, Waves & Optics **Geology** Geochemistry Igneous Petrology Metamorphic Petrology Sedimentary Petrology Structural Geology Tectonics **Geophysical Methods & Interpretation** Analytical Methods Marine Geophysics Electrical and Electromagnetic Methods Gravity & Magnetics Seismology Radiometrics Rock Properties/Rock Physics Seismic Interpretation **Modern Physics** **Near Surface Geoscience** Environmental Geophysics Geomorphology Geographic Information Systems Glacial/Quaternary Geology Remote Sensing **Regional Geology** Geology of Canada Geology of North America

Table 3

Group:	2C – Other Geoscience (NOTE: These lists are not meant to be exhaustive)			
		Streams		
	Groups	**Geology**	**Environmental Geoscience**	**Geophysics**
2C	continued	**Stratigraphy** Historical Geology Sequence Stratigraphy Stratigraphic Paleontology Geochronology **Structure** Global Tectonics Tectonics Structural Geology	**Sedimentology** Chemical Sedimentology Clastic Sedimentology Carbonate Sedimentology Glacial Geology Limnogeology **Stratigraphy** Historical Geology Sequence Stratigraphy Stratigraphic Paleontology Geochronology **Structure** Global Tectonics Tectonics Structural Geology	**Resource Geoscience** Fluid Flow in Porous Media Hydrogeology /Hydrology Mineral Deposits Geology Petroleum Geology Reservoir Engineering Well Log Analysis



4 Geoscience Practice Experience Requirement

Following their education, geoscience graduates need supervised practice experience working in the capacity of a geoscientist to obtain the necessary range of capabilities required to enter independent practice. Individuals preparing to practice independently must have worked in the capacity of a geoscientist both at sufficient depth and over sufficient breadth to become aware of the responsibilities and accountabilities associated with professional practice, as well as to gain the ability to recognize their own limitations as a practitioner.

As a result of meeting the geoscience practice experience requirement as set out in this document, an individual is deemed to be able to practice in a competent manner consistent with generally accepted standards in the profession, without supervision or direction, and within a reasonable timeframe. The individual can apply their geoscience knowledge in an informed manner, based on the situation at hand and can anticipate what outcomes to expect in a given situation, and can respond appropriately.

Individuals who have met this requirement also will recognize unusual, difficult-to-resolve and complex situations, and will take appropriate steps to address them based upon their skill and experience. This may include seeking advice or consultation, reviewing research literature, and/or referring to other more experienced and qualified professionals for assistance and advice.

The recommended amount of supervised experience in geoscience practice is 48 months, a minimum 36 months of which must be obtained following completion of the geoscience knowledge requirement. It may take an individual more than four calendar years from completion of the knowledge requirement to accumulate the 48 months of appropriate supervised experience in geoscience practice to meet this requirement. A range of experience is essential to ensure that a practitioner has sufficient depth and breadth of practice to commence practicing independently in a professional capacity.

Geoscience practice experience should be verified, either by the licensed professional geoscientist(s) who guided and supervised the practice experience, or by other licensed professional geoscientists directly familiar with the practice experience.

The geoscience practice experience requirement is laid out as a set of guiding principles in Section 4.1.

4.1 *Guiding Principles for Obtaining and Assessing Geoscience Practice Experience*

Determining acceptable geoscience practice experience is largely a function of the nature, quality, duration, currency, and progression of that experience. By meeting the requirement below, applicants can be expected to have received sufficient geoscience practice experience to demonstrate evidence of:

- sound professional judgment,
- an ability to function in multi-disciplinary teams,
- an ability to recognize their own limitations, and
- an awareness of the importance of quality assurance and control, accuracy, thoroughness, and critical thought in their work.

1) A minimum of 48 months of cumulative practice experience in geoscience is required.
   a) This should be obtained under the guidance and supervision of a professional geoscientist.
   b) It does not have to be through continuous practice, with a single organization, or in a single role.
   c) Up to 12 months of acceptable geoscience practice experience may be obtained through supervised experience undertaken after completion of the first half of a B.Sc. degree program in geoscience and prior to completion of a B.Sc. degree in geoscience.
   d) Up to 12 months of acceptable geoscience practice experience may be obtained through completion of a post-baccalaureate degree involving a research thesis in geoscience.
   e) For completion of both a thesis-based Masters degree and a Doctoral degree, no more than 24 months of total geoscience practice experience will be recognized.
   f) At least 12 months of geoscience practice experience must be obtained either working in Canada, or in a working environment that is equivalent to that which might be obtained by working in Canada.

2) Geoscience practice experience should be consistent with the individual's geoscience knowledge, and should be current.

3) Geoscience practice experience should involve evidence of a progressive increase in the level of responsibility over time.

4) Geoscience practice experience should involve the following components:
   a) **practical experience**, which may include field/lab data collection, project function and operation, evaluation of geoscience limitations, project time constraints, project costs, data reliability and uncertainty; equipment maintenance, safety, environmental impact, and hazard and risk recognition;
   b) **application of geoscience theory**, which may include development of concepts and hypotheses, analysis/evaluation of data (maps, graphs or tables), result integration/synthesis and testing or implementation;
   c) **geoscience project management**, which may include planning, scheduling, budgeting, supervision, project control, safety and risk management, and leadership;
   d) **communication skills**, which may include written work and oral presentations to a variety of audiences (supervisors, co-workers, government regulators, clients and general public) and on a variety of scales (from daily record-keeping to major reports);
   e) **professional accountability and ethical responsibilities** to the public, profession and client or employer; and
   f) **awareness of the societal implications of geoscience**, which may include the recognition of geoscience value and benefits, the inter-relationship between society and the planet Earth, government regulations, environmental impacts, economic well-being, safety issues, geoscience education, and geoscience industries.

GEOSCIENCE PRACTICE EXPERIENCE REQUIREMENT

5 Geoscience Knowledge Unit Descriptors

Air Photo Interpretation	Application of aerial photographs to geological mapping and terrain analysis; interpretation of geological structures and landforms.
Analytical Methods (for Geophysics)	Infinite series of constants; sequences; series of functions; uniform convergence; power series; Taylor series; Weierstrass Approximation; iterative methods for nonlinear equations in one variable; interpolation and polynomial approximation; discrete least-squares approximation; numerical differentiation and integration.
Analytical Methods (for Geoscience)	Instruments and methods used to analyze the chemistry of samples, such as ICP-MS (inductively-coupled plasma mass spectrometry), IC (ion chromatography), XRF (x-ray fluorescence), XRD (x-ray diffraction), AAS (atomic absorption spectrophotometry). Understanding of the theory of the instruments as well as practical aspects of sample preparation and improving data quality.
Applied Geophysics	Reflection and refraction seismology, gravity and magnetics, and electrical and electromagnetic methods applied to exploration and environmental problems.
Aqueous Geochemistry	Theoretical and applied aspects of aqueous solution chemistry. Topics include: methods for collection and preservation of water samples in the field, laboratory analysis of waters, theory and application of aqueous thermochemical models.
Atmospheric Geochemistry	Air pollution and atmospheric processes. Ability to study and understand composition, sources and distributions of atmospheric pollutants and other naturally occurring compounds, like ozone.
Biogeochemistry	Biotic controls on the chemistry of the environment, and geochemical control of the structure and function of ecosystems. The influence of biota on geochemical processes and composition.
Biology (1B)	Course covering one or more of these topics: (a) unity, (b) diversity, (c) continuity and (d) interaction. Unity encompasses the historical events leading to major biological concepts, the chemistry of cells, cell structure and hereditary mechanisms. Diversity deals with the variety of cell types, organ systems and organisms from developmental and evolutionary points of view. Continuity covers the mechanisms of heredity as they relate to evolution. Darwinian evolution and the evolution of man are emphasized. Interaction places the emphasis on the ecosystem and the interaction of organisms with their environment, or Higher-level course for degree in science or engineering with a bioscience prerequisite - e.g. vertebrate zoology, invertebrate zoology, microbiology.
Calculus	Differential and integral calculus to multiple integrals, with applications. Trigonometric, exponential and logarithmic functions and their inverses. Numerical integration, Taylor Series. Partial differentiation.
Carbonate Sedimentology	Description and genesis of carbonate rocks, including facies and their relationship to depositional environments.
Chemical Sedimentology	Principles and applications of geochemistry to sediments and sedimentary rocks; includes modern sedimentary environments, post-depositional processes and reconstructing paleoenvironments. Application of basic principles of physical chemistry to the solution of sedimentological problems.

Chemistry (1A)	First year (or higher) university/CEGEP level Chemistry for Science or Engineering degrees with labs such as: "Chemistry I": Basic chemical concepts. Stoichiometry. Gas laws. Periodic table and the chemistry of selected elements. Atomic and molecular structure. Chemical bonding. Structures of organic compounds. States of matter and phase changes. Properties of solutions, or, "Chemistry II": Acid/base concepts. Chemical kinetics and equilibrium. Acid-base and solubility equilibria. Elementary thermodynamics. Oxidation and reduction, electrochemistry, or "General Chemistry I": Atomic and molecular structure, stoichiometry in chemical reactions. Chemical bonding. Structures and reactions of organic and inorganic compounds. Materials science, or "General Chemistry II": Gas laws. Kinetics and chemical equilibrium, acids and bases. Oxidation-reduction processes and electrochemistry. Elementary thermodynamics.
Chemistry (1B)	Chemistry I or II, whichever was not counted in 1A or Physical Chemistry: (a second-year or higher level course with first-year chemistry prerequisite) Fundamental concepts of matter in relation to energy. The laws of classical thermodynamics and their application to the properties of gases, liquids, solids and solution. Transport phenomena. The basic laws of chemical kinetics, and their application to reactions in gaseous and liquid phases. Catalysis, or Organic Chemistry: (a second-year or higher level course with first-year chemistry prerequisite) A study of compounds of carbon with emphasis on reaction mechanisms to illustrate the basic principles of organic chemistry. Structure and bonding, physical properties, and stereochemistry; addition, elimination, and displacement reactions by function group classification; structure reactivity relationships; aromaticity and aromatic substitution; condensation reactions; spectroscopic methods for structure determination, or Inorganic Chemistry: (a second-year or higher level course with first-year chemistry prerequisite) The structure of many-electron atoms, bonding and stereochemistry in inorganic compounds, elementary crystallography, solid-state science and aspects of inorganic solution chemistry. The chemistry of metals and ligand field theory; coordination compounds, metal carbonyls and organo-metallic compounds of the transition elements; descriptive chemistry of the first-row transition elements; industrial extraction of metals; uses of transition metal complexes as catalysts; an introduction to the role of metals in biology, or Higher-level chemistry courses for degree in science or engineering that require one or more of the above courses as prerequisites.
Clastic Sedimentology	Study of physical processes of erosion, transportation and deposition for the interpretation of depositional facies and formation of sedimentary rocks.
Climatology	Basic principles and processes involved in physical and dynamic climatology and measurement techniques.
Coal Geology	Origin, composition, distribution and classification of coal deposits; methods of coal exploration, coal petrology and determination of coal quality. Use of organic matter as a geothermometer and in-basinal analysis.
Complex Analysis	Mapping by elementary functions; conformal mapping; applications of conformal mapping; Schwartz-Christoffel transformation; Poisson integral formula; poles and zeros; Laplace transforms and stability of systems; analytic continuation.
Computer Applications in Geosciences	Applications of mathematical modeling and geostatistical procedures to practical problems with geological context. Ability to use computer techniques to model and analyze geologic datasets.

Computer Controlled Instrumentation	Data communications, including signals, modulation and reception. Performance of optimum and sub-optimum systems. Data transmission characteristics, including half/full duplex, asynchronous/synchronous, point-to-point/multidrop and character/bit oriented. Error detecting and correcting codes. Character sets and message communications. Local area networks.
Computer Programming (1B)	Computer science course that requires students to develop familiarity with a high level programming language (one of Fortran, Pascal, or C) and develop facility in writing computer programs. Organization of stored program computers; principles of structured programming (input/output, assignment, selection and repetition, modular design using functions and procedures/subroutines, data structures including arrays and text files; design and testing of algorithms; introduction to numerical methods) curve fitting, numerical integration, root finding, or Computer Programming: Application of programming techniques using a high-level language for the manipulation of large data sets and the solution of problems in mathematics and physics. NOTE: Computer science courses that do not involve any programming are not acceptable.
Condensed Matter Physics	Crystal structure. Classification of solids and their bonding. Elastic, electric and magnetic properties of solids. Lattice structure, Fermi surfaces.
Contaminant Transport	Chemical and biological processes in surface water and groundwater systems. Topics include: water quality, contaminant transport and dispersal, fluid-sediment interactions, remediation of contamination. Techniques will include the use of thermochemical models, numerical modelling of contaminant migration, and examination of case studies.
Continuum Mechanics	Stress and strain in continuous media; elasticity. Mechanics of fluid flow in two and three dimensions. Thermodynamics and mechanics of compressible and viscous flows. Turbulence and convection.
Crystallography	Crystallography and crystal systems (Crystal chemistry, crystal structure, symmetry, crystal systems).
Differential Equations	First- and second-order linear differential equations with applications. Series solutions about regular points and singular points.
Digital Signal Processing	Introduction to the theory of basic computational techniques of digital processing in geophysics sampling theory; Fourier transforms, convolution, correlation, z-transforms, design and application of digital filters, deconvolution, spectral analysis, 2D signal processing.
Earth Systems	Interrelationships between the Earth's atmosphere, hydrosphere, geosphere and biosphere through time.
Economic Geology	The economics of exploration and exploitation with respect to metalliferous raw materials. Exploration logistics and planning. Property and prospect evaluation. Drilling and sampling techniques. Reserve and grade estimation.
Electrical and Electromagnetic Methods	Electromagnetic, resistivity, induced polarization, and self-potential methods applied to problems in the search for metallic mineral deposits. Theory and application of Maxwell's equations. Direct and indirect methods of inversion.
Electricity and Magnetism	Electrostatics, DC circuits, electric field, electric potential, Gauss's law, electromagnetic induction, capacitance. AC circuits. Electrical and magnetic properties of materials.
Electromagnetic Theory	Time varying electromagnetic fields up to Maxwell's Equations including topics such as induced fields. Gradient, divergence, curl. Boundary value problems in electrostatics and magnetostatics. Electrical and magnetic properties of materials.
Electronics for Scientists	Basic principles of electronics. Active and passive components, feedback, operational amplifiers, digital electronics, interfacing.

Engineering Geology	Physical properties of soils and rocks. Measurement methods and their relationship to geoscience surveys and interpretation. Engineering site surveys and exploration, geological aspects of a given site with regard to the engineering design of foundations, hydraulic structures and the stability of natural or man-made slopes and open cuts.
Environmental Geochemistry	Application of chemical principles to predicting the fate of organic and inorganic pollutants in the terrestrial environment. Understanding of thermodynamic and kinetic processes which affect the fate of pollutants.
Environmental Geology	Applications of geoscience to problems created by man's occupancy and exploitation of the physical environment. Understanding of the relationship, both positive and negative, between people and their geologic habitat.
Environmental Geophysics	Methods for determining the composition and structure of shallow subsurface materials, including refraction seismic, high resolution reflection seismic, direct current resistivity, induced polarization (IP), low induction number electromagnetic profiling and depth sounding, ground penetrating radar, magnetics and microgravity.
Exploration Geochemistry	Distribution of elements in rocks, soils, sediments and other natural media in relation to mineralization. Ability to apply a broad spectrum of geochemical techniques to mineral exploration.
Exploration Geophysics	Applied geophysics: reflection and refraction seismology, gravity and magnetics, electrical and electromagnetic methods applied to exploration and environmental problems.
Field Techniques (for Geology & Environmental Geoscience)	Navigation, geological mapping techniques, sampling, field reports.
Field Techniques (for Geophysics)	Field surveys and data collection techniques for seismic, gravity, magnetic, electromagnetic, electrical and radiometric methods. Surveys for elevation and position location. Field analysis of geophysical data. Instrumentation.
Fluid Dynamics	Flow of viscous and non-viscous fluids, dimensional methods in turbulence.
Fluid Flow in Porous Media	Porosity, fluid saturation, permeability, interfacial tension, wettability, capillary pressure, effective and relative permeability, steady and unsteady state fluid flow.
Fluid Mechanics	Fluid properties as they relate to flow in conduits and open channel and measurement of flow. Application of fluid mechanics to geo-engineering problems.
Geochemistry	Chemistry of Earth and Earth environments, geological processes, geological cycles and reservoirs, stability diagrams, balancing chemical reactions.
Geochronology	Theory and systematics of radioactive decay with application to the dating of rocks.
Geographic Information Systems	Fundamentals, concepts and components of geographic information systems (GIS) as applied to geoscience. Ability to acquire, manipulate and analyze digital terrain data for geological, engineering and/or environmental applications.
Geology of Canada	Description and understanding of the processes involved in the development and evolution of the Precambrian and Phanerozoic rocks of Canada.
Geology of North America	The application of plate tectonic theory to the Precambrian and Phanerozoic evolution of the North American continent.
Geomagnetism/ Paleomagnetism	Fundamental principles of rock magnetism, paleomagnetism, and geomagnetism; origin and behaviour of the geomagnetic field; physical and chemical basis of paleomagnetism; physics of magnetism as it applies to rocks and minerals; origin of remanent magnetization; mineralogy of magnetic minerals; paleomagnetic measurement techniques.

Geomorphology	Processes and principles of landform development, introduction to air photo interpretation.
Geomorphology (Advanced)	Examination of one or several geomorphic environments, including applied topics. Recognition and interpretation of sediments and landforms and the processes involved in their formation. In the case of applied geomorphology, to analyze problems caused by geomorphic processes pertinent to engineering or resource development.
Geophysics	Applied or theoretical geophysics: reflection and refraction seismology, gravity and magnetics, electrical and electromagnetic methods.
Geophysics (Advanced)	Advanced techniques in geophysical data acquisition and interpretation, including theoretical basis. sound basis of understanding in the theoretical background of advanced geophysical techniques.
Geostatistics	Theory and application of geostatistics. Understanding of available methods and their limitations. Preparation and analysis of data for use in geostatistical models, understand the basics of geostatistical modeling, and ability to build and interpret complex geological models.
Glacial Geology	Processes and products of glaciation (the growth, movement, and decay of glacial ice masses) and interpretation of glacigenic sediments and landforms. The stratigraphic and geomorphic record of glaciation and its relationship to climate change.
Glaciology	Properties and occurrences of snow and ice on the Earth's surface, especially active glaciers and ice sheets and their effects on the Earth's surface. Understanding of critical and emerging scientific issues related to the Earth's cryosphere.
Global Geophysics	Physics of the Earth, gravity, the geoid, geomagnetism, paleomagnetism, heat flow, earthquake seismology, mantle convection.
Global Tectonics	Global aspects of plate tectonics, basin development and regional geology through time. Contributions of geophysics, sedimentary basin analysis, geochemistry and petrology to the modern plate tectonic model. Analysis and interpretation of major structural provinces as they relate to the plate boundary interactions.
Gravity and Magnetics	The nature of the magnetic and gravity fields of the Earth. Density, porosity, magnetic susceptibility. Gravity meters and magnetometers. Potential theory. Theory and applications of gravity and magnetic methods of geophysical exploration. Filtering, upward and downward continuation techniques. Reduction to the pole. Modeling and inversion methods.
Historical Geology	Synthesis of the Earth's evolution, including the impact of plate tectonics on the distribution and formation of land masses, rock types and life through geologic time.
Hydrogeology	Theory of groundwater flow, groundwater resources, role of groundwater in geologic processes, controls on groundwater chemistry.
Hydrology	Description and analysis of surface and shallow groundwater at various scales, techniques of measurement and data analysis.
Igneous Petrology	Classification, mineralogy and textures, igneous processes origin, evolution, description in hand sample and thin section.
Industrial Minerals	Industrial rocks, minerals and aggregates; geologic origin, occurrence and mutual relationships; classification, extraction, preparation and uses; properties, classification and origin of coal; structural control, exploitation of industrial minerals deposits, grade and tonnage estimation.
Integral Transforms	Fourier and Laplace transforms and their applications in the physical sciences.
Isotope Geochemistry	Study of the relative and absolute concentrations of stable and radiogenic isotopes in the Earth. Application of isotopes to a wide range of geologic uses such as age, geothermometry and barometry, fractionation and paleotemperature.

Limnogeology	The processes and products of modern and ancient lake systems. The physical, chemical, isotopic, biological, and geological record of lakes.
Linear Algebra	Vector and matrix algebra, determinants, linear systems of equations, vector spaces, eigenvalues and eigenvectors. Applications.
Low Temperature Geochemistry	Low-temperature geochemical equilibria, primarily in aqueous systems. Development of skills in solving geochemical problems in the environmental field of practice.
Marine Geophysics	The application of the various geophysical techniques to the study of the sea floor and the examination of principal results obtained. The processes involved in the creation, evolution and destruction of ocean basins and the implications of the experimental observations.
Mathematical Physics	Functions of a complex variable; residue calculus; introduction to Cartesian tensor analysis; matrix eigenvalues and eigenvectors; diagonalization of tensors; vector differential operators in curvilinear coordinate systems; introduction to partial differential equations; boundary value problems; derivation of the classical equations; separation of variables.
Mathematics (1A)	First-year (or higher) university CEGEP-level Mathematics courses for Science or Engineering degrees such as: Calculus I: Review of analytical geometry. Differentiation and integration of simple functions. Applications, or Calculus II: Differentiation and integration of trigonometric, exponential and logarithmic functions. Indeterminate forms and improper integrals. Applications, or Introductory Calculus: Functions and graphs, differentiation and integration of simple functions, analytical geometry. NOTE: Remedial high school level algebra, trigonometry, geometry or pre-calculus, are not acceptable.
Mathematics (1B)	Calculus I or II, whichever was not counted in 1A, or Differential equations and transform methods: linear ordinary differential equations; the Laplace transformation; series solutions of differential equations; boundary value problems and orthogonal functions; Fourier series; Fourier integrals, or Linear algebra: linear transformations; matrices and matrix operations; determinants; simultaneous linear algebraic equations; eigenvalues and eigenvectors, or Vector analysis: vector algebra; vector functions and operators; orthogonal curvilinear multiple coordinates; applications of partial derivatives, multiple integrals, line and surface integrals; integral theorems, or Higher-level mathematics courses for science or engineering majors that require one or more of the above courses as prerequisites.
Mechanics	Introductory Newtonian particle mechanics and rigid bodies in rotational equilibrium: kinematics, Newton's laws, conservation of momentum and mechanical energy.
Metamorphic Petrology	Classification, mineralogy and textures, metamorphic processes, facies, P-T-composition interpretation, description in hand sample and thin section.
Meteorology	Composition and structure of the atmosphere: solar and terrestrial radiation, thermodynamic processes, forces and related small - and large - scale motions. Ability to analyse and use atmospheric data for solving environmental problems.

Micropaleontology	Description and classification of microfossils and their use in stratigraphy, sedimentology and environmental interpretations.
Mineral Deposits Geology	Ore formation and mechanisms of concentration. Stratigraphic and structural control of mineral deposits and their metallogeny. The application of chemical principles to the understanding of mineral deposits.
Mineralogy and Petrology	Systematic mineralogy (including: identification, classification and description), Physical and chemical properties of minerals. Crystallography and crystal systems (symmetry, crystal structure, crystal systems) Descriptions of rocks in hand samples. Optical techniques in mineral identification.
Modern Physics	Experimental evidence leading to the development of quantum mechanics including the photo-electric effect, the Compton effect, X-ray production and electron diffraction; Heisenberg uncertainty principle, Schrodinger theory of quantum mechanics; the simple harmonic oscillator; atomic physics; hydrogen atom; periodic table.
Natural Hazards	Causes of disasters such as earthquakes, tsunamis, volcanic eruptions, mud flows, landslides, avalanches, flooding, tornadoes and hurricanes, and other critical phenomena such as sinkholes, ozone depletion and radiation, carbon dioxide and global warming, El Niño, toxic natural materials and pollution, and extraterrestrial impacts. Surveys of historic disasters and their effects on life on Earth. Methods of prediction and prevention of disasters and precautions for the mitigation of their effects.
Numerical Methods/ Computing	Basic methods in computational physics including numerical algorithms applied to problems in nonlinear mechanics (chaotic dynamics, iterative maps, etc.), wave motion, electrodynamics, statistical physics, and quantum mechanics, parallel computing methods, writing programs and running simulation algorithms.
Oceanography	The physical, chemical, and biological processes in oceans and their resulting sedimentary record. The influence of oceans on land and climate.
Optical Mineralogy	Properties of light and its interaction with mineral grains: reflection, refraction, polarization, interference phenomena, extinction, colour and pleochroism. Refractometry; isotropic, uniaxial and biaxial optics; interpretation of interference figures.
Optics	Review of waves and EM theory, the electromagnetic spectrum, interaction of light with matter and optical materials, geometrical optics and aberrations, polarization, electro-optic modulators, diffraction, diffraction gratings, spot size and resolution of imaging systems, Fourier optics and image processing, laser fundamentals and examples of laser systems.
Ore Petrology	Study of ores in hand specimen, polished and thin section, and their mineral phase relations.
Paleobiology	Principles of classification, comparison of fossil with modern forms, morphology of invertebrate fossils, their evolutionary history and paleoecologic significance.
Paleoclimatology	The proxies in the geological record used to identify past climate, the interrelationship of water, ice, atmosphere, biosphere and continents in influencing climate change through time.
Paleoecology	Reconstruction of past environments. Ability to correlate between modern ecosystems and those in the fossil record by applying biofacies and lithofacies.
Paleoenvironmetal Studies	Analysis of proxies to recreate environments of the past. Ability to utilize climate proxies such as plant and insect macrofossils, diatoms, chironomids, forams, dinoflagelates, and paleolimnology.
Paleontology	Description, classification and identification of fossils. Using fossils in stratigraphy, sedimentology, Earth history and tectonics.

Palynology	Concepts and techniques in palynological investigations of marine and terrestrial Quaternary deposits. Ability to identify pollen and other microfossils such as spores, dinoflagellate cysts, acritarchs, chitinozoans and scolecodonts to solve environmental problems.
Partial Differential Equations	Orthogonal sets of functions. Numerical solution of partial differential equations. Classification of second-order linear equations. Hyperbolic and parabolic equations, methods of descent.
Pedology	The processes of formation and identification of soils. The interaction of Earth materials with the atmosphere, biosphere, and hydrosphere and the resulting weathered product.
Petroleum Geology	Origin and distribution of petroleum. Geochemistry and maturation of organic matter; microbiological and thermal degradation of hydrocarbons, conventional and unconventional source and reservoir rocks; principles of primary and secondary migration; diagenesis of carbonate and clastic reservoir rocks, with reference to seals and traps.
Physics (1A)	First-year (or higher) university CEGEP-level Physics courses for Science or Engineering degrees w/labs such as: Physics I: Vectors, kinematics in 1D, kinematics in 2D, forces and Newton's laws of motion, work and kinetic energy, potential energy and conservative forces, linear momentum and collisions, linear and rotational kinematics, rotational dynamics, static equilibrium, gravitational forces, elasticity and simple harmonic motion, oscillations and resonance, waves and sound, <u>or</u> Physics II: Fluids, temperature and heat, kinetic theory of gases, thermodynamics, phase changes, electric charge, electric field, electric potential and potential energy, electric currents, DC circuits, AC circuits, magnetism, Ampere's law, magnetic flux and Faraday's law of induction, <u>or</u> Introductory Physics I: Fundamental concepts, definitions and physical laws. Vectors, kinematics and statics. Newton's laws, force, work and energy, conservation laws, <u>or</u> Introductory Physics II: Applications of Newton's laws. Particle dynamics. Rotational Mechanics, Work and energy with variable forces. Fluid mechanics, kinetic and wave theory. First law of thermodynamics.
Physics (1B)	Physics I or II, whichever was not counted in 1A, <u>or</u> Thermodynamics: (a second-year or higher level course with first-year physics prerequisite) Thermodynamic states of simple systems; the laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; energy of state; compressibility charts and steam tables; calculation of property changes; enthalpy; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, the Gibbs phase rule; gas-vapor mixtures, psychometrics, <u>or</u> Optics and waves - a second year or higher level course with first year physics prerequisite, <u>or</u> Planetary physics – a second-year or higher level course for science or engineering majors with first year physics prerequisite. Higher level physics courses for science or engineering majors that require one or more of the above courses as prerequisites. NOTE: general interest courses such as Introduction to Astronomy are not acceptable.
Physics of the Earth	Physics of the Earth, gravity, the geoid, geomagnetism, paleomagnetism, heat flow, radioactivity and geochronology. Earthquake seismology. Solar system, meteorites.
Quaternary Geology	Glacial and non-glacial depositional environments, Quaternary stratigraphy, history and the processes responsible for change; dating methods. Interpretation of sediments, facies associations and land forms in a chronological context.

Radiometrics	Common rock-forming radioactive minerals; gamma ray spectra; gamma spectrometers and crystal detectors; ground and airborne radiometric techniques; geological interpretation using radiometrics; borehole radiometric logging.
Remote Sensing	Imaging of the Earth by EM waves, with data analysis. Recognition of surficial materials relevant to mapping or geological/engineering applications.
Reservoir Engineering	Rock properties, rock-fluid interactions, flow through porous media, and material balance.
Resource Geotechnics	Application of geotechnics to the resource sector with particular emphasis on forestry and minerals. Understanding of the use and influence of geotechnics in the forestry, mining and the petroleum industries.
Rock Mechanics	The mechanical properties of rock, rock behaviour and stability analysis as influenced by excavation, structural geology, groundwater and shaking. Application of basic rock mechanics to common geoscience problems.
Rock Properties or Rock Physics	Physical properties of minerals and rocks. Measurement methods and their relationship to geophysical surveys and interpretation.
Sedimentary Petrology	Origin of sedimentary rocks, including the physics and chemistry of their deposition, diagenesis and weathering processes. Laboratory includes hand specimen and microscopic petrography, classification, and grain size and shape analysis.
Sedimentation & Stratigraphy	Principles of correlation, facies concept, dynamic processes and their geological record.
Sedimentology	Modelling of modern and ancient depositional environments, facies and sequence stratigraphy analysis.
Seismic Interpretation	Principles of seismic stratigraphy, and seismic sequence analysis, and structural interpretation of reflection seismic data, depth conversion methods.
Seismic Methods	Basic understanding of seismic wave propagation and seismic velocities of rocks and overburden; principles of refraction and reflection seismology; field methods to acquire and process refraction seismic data; methods to acquire and process reflection seismic data; obtaining velocity and depth information from refraction and reflection surveys; basics of seismic resolution.
Seismology	Theory of body and surface wave propagation, techniques in exploration seismology. Earthquake source mechanisms. Seismic attenuation. Acquisition design of three-dimensional (3-D) seismic surveys; processing and interpretation of 3-D seismic data volumes. Multi-component seismic methods. Introduction to refraction and reflection seismic methods applied to the exploration for resources and their use in engineering studies. Elasticity theory, seismic instrumentation, velocity surveys, near-surface corrections.
Sequence Stratigraphy	Mapping of sedimentary facies for the purpose of the identifying time relationships.
Signal Analysis	Advanced methods of data analysis in exploration and production geophysics including advanced filtering, migration, inversion and tomography.
Soil Mechanics.	Physical properties field description and engineering classification of soil. Principles of effective stress, shear strength, consolidation, permeability, seepage and settlement. Understanding of the basic principles of soil mechanics and fundamentals of application in engineering practice such as slope stability, road design, foundations.
Soil Science	Physical, chemical and biological properties of soils, weathering and soil formation. Principles of identification and classification. Ability to identify a wide range of soil types and understand the general processes of their formation.

Statistics (1B)	Descriptive statistics; probability distributions, estimation; hypothesis testing; normal, chi-squared, t- and F-distributions; mean and variance tests; regression and correlation; and the use of statistical computer software.
Stratigraphic Paleontology	Application of palaeontological information in stratigraphy including chronostratigraphy, chronostratigraphic units, stratigraphic correlation and paleoenvironmental reconstructions. General study of the world faunal successions and/or detailed study of selected stratigraphic systems.
Structural Geology (2A)	Description and classification of geological structures, maps, cross-sections, stereographic projections, mechanical principles, stress and strain.
Structural Geology (2C)	Structural features of complexly folded and faulted strata. Simple statistical analysis of structural data. Analysis of strains. Computer-based procedures for determining the geometry of faults and folds. Structural analysis in plutonic and metamorphic rocks.
Technical Writing	Principles of effective written communication in geoscience in technical, professional and business contexts.
Tectonics	Analysis and interpretation of major structural provinces as they relate to the plate boundary interactions.
Thermodynamics	Thermodynamic states of simple systems; the fundamental relation of thermodynamics; the first and second laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; energy of state; compressibility charts and steam tables; calculation of property changes; enthalpy; Helmholtz and Gibbs function; the Maxwell equations; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, the Clapeyron equation, Gibb's phase rule, gas-vapor mixtures, psychrometrics.
Thesis	Experimental, theoretical, applied research project in an area of geoscience, carried out independently and under faculty supervision.
Vector and Tensor Analysis	Vector algebra; vector functions and operators; orthogonal curvilinear multiple coordinates; applications of partial derivatives, multiple integrals, line and surface integrals; integral theorems.
Vibrations, Waves and Optics	Harmonic damped and forced oscillators. Geometrical optics, interference, waves, diffractions. Wave-equation.
Volcanology	Physical and chemical mechanisms responsible for volcanologic phenomena on Earth and other geologically active planets in our solar system. Understanding the root causes of volcanic activity, especially within the framework of plate tectonic theory. Physical properties and chemical compositions of magmas. Flow morphology. Pyroclastic eruptions and related deposits. Type and magnitude of volcanic hazards.
Well Log Analysis	Petrophysics and modern well-logging methods. Theory and applications of measurements of physical properties of the formation near the well bore, types of well logging devices, interpretation and use of information in petroleum and natural gas engineering.
X-Ray Crystallography	Microstructural concepts and crystallography. Diffraction analysis of crystal structure using X-ray and electron beams. Imaging using various techniques: microscopes, TEM, SEM and ESEM. Chemical microanalysis in electron microscopy.

6 Glossary of Terms

Admissions and registration officials	*Staff and other employees of the regulators who are responsible for processing applications for registration.*
Agreement on Internal Trade	*Agreement signed by all provinces and territories in Canada respecting inter-provincial trade for persons, goods, services and investments.*
Applicant	*Individual who is applying to a regulator to be registered as a professional geoscientist.*
Area of Competence	*Area of geoscience in which an individual is competent to practice based on sound geoscience knowledge and appropriate experience.*
Board of Examiners	*Body created under the legislative act or statutes in each jurisdiction to govern the approval of applicants applying to register as professional geoscientists. Also referred to as the Registration Committee.*
CEGEP	*Pre-university education program of 2-3 years offered in Quebec that covers the equivalent of the final year of secondary school and the first part of a university program in other parts of Canada.*
Character, reputation and conduct	*Three related attributes that regulators normally consider in determining the suitability of an applicant for registration as a professional. Reputation is an acquired attribute that flows from a respected approach to work in an Area of Competence. Good conduct pertains to a having a clean discipline record. Good character is the embodiment of both good reputation and good conduct.*
Course	*Unit of study in an area of geoscience knowledge offered as part of a typical Bachelor of Science or Baccalaureate Degree (B.Sc.) in Geoscience at a Canadian university.*
Current (Currency)	*Geoscience experience that is recent in time so that it demonstrates that the applicant is actively involved in the practice of geoscience.*
Definition of practice	*Activities that fall within the Definition of Professional Geoscience as set out in the Legislative Acts and Statutes that govern the profession in each province and territory in Canada in which regulation applies.*
Educational Unit/EU	*Formal instruction equivalent to a one-semester (13-week) course in a typical Bachelor of Science or Baccalaureate Degree (B.Sc.) in Geoscience at a Canadian university.*
Environmental Geoscience	*Stream of geoscience education that is focused on the knowledge required to practice in the area of Earth science applied to the natural environment, in particular the near-surface environment and the interaction between the geosphere and the hydrosphere.*
Generally accepted standards	*Level of skill and care that would be expected of a typical individual practicing professional geoscience within an Area of Competence.*
Geology	*Stream of geoscience education that is focused on the knowledge required to practice in the area of pure and applied Geology.*
Geophysics	*Stream of geoscience education that is focused on the knowledge required to practice in the area of pure and applied geophysics.*
Geoscience knowledge	*The body of knowledge in science and geoscience that would be typically expected of an individual capable of practicing professional geoscience with an Area of Competence.*

Geoscience theory — *Development of geoscientific concepts and hypotheses, analysis, evaluation and interpretation of geoscientific data (maps, graphs or tables), integration and synthesis of results, testing, implementation and reporting.*

Group — *One of the five broad groups into which the components of geoscience knowledge are divided, for the purposes of this document. The five groups are; Compulsory Foundation Science, Additional Foundation Science, Compulsory Foundation Geoscience, Additional Foundation Geoscience, and Other Geoscience/Science.*

Independent practice — *Practice in a competent manner, without supervision or direction, and within a reasonable timeframe, including the ability to recognize unusual, difficult-to-resolve and complex situations that may require seeking advice or consultation, reviewing research literature, and/or referring to other more experienced and qualified professionals for assistance and advice.*

Knowledge outcome — *Skills and abilities in an area of science or geoscience resulting from completion of and assessment following a Course or Educational Unit ("EU").*

Legislative act — *Act of provincial or territorial parliament setting out the regulation of the practice of professional geoscience in that jurisdiction.*

License — *Permit giving an individual registered with a self-regulating professional association the ability to practice professional geoscience in that jurisdiction.*

Panel — *Body created under the legislative act or statutes in a jurisdiction to govern appeals of decisions regarding non-acceptance or delays in acceptance of applicants applying to register as professional geoscientists.*

Principles of the geological sciences — *Generally accepted basis of knowledge and theory that comprises an understanding of the planet Earth and Earth processes.*

Professional Geoscience — *The practice of professional geoscience means the performing of any activity that requires application of the principles of the geological sciences, and that concerns the safeguarding of public welfare, life, health, property, or economic interests, including, but not limited to:*

a) investigations, interpretations, evaluations, consultations or management aimed at discovery or development of metallic or non-metallic minerals, rocks, nuclear or fossil fuels, precious stones and water resources;

b) investigations, interpretations, evaluations, consultations, or management relating to geoscientific properties, conditions or processes that may affect the well-being of the general public, including those pertaining to preservation of the natural environment.

Professional geoscientist — *An individual who is registered with a self-regulating professional association and who practices geoscience as an independent professional.*

Professional Practice and Ethics Exam — *Formal exam to verify individuals' knowledge of professional practice issues, including law and ethics before they are permitted to practice independently. Exams are normally multiple choice and three hours in duration.*

Professional registration — *Formal recognition of an individual to practice in a particular jurisdiction, by the placement of that person's name on the register and issuance of a licence to practice.*

Registered	*The act of being accepted for practice in a particular jurisdiction, by the placement of the individual's name on the register and issuance of a licence to practice.*
Registration Committee	*Body created under the legislative act or statutes in each jurisdiction to govern the approval of applicants applying to register as professional geoscientists. Also referred to as the Board of Examiners.*
Regulated	*The act of being governed in the practice of professional geoscience by a self-regulating professional association set up for that purpose.*
Regulator	*A self-regulating professional association set up under a legislative act or statutes for the purpose of governing the practice of professional geoscience in that jurisdiction.*
Second Level	*Areas of study in science or geoscience that are not at an introductory level and which require a foundational knowledge and understanding of that general topic, through prior instruction or study.*
Self-regulating professional association	*An association set up under a legislative act or statutes that allows the profession to regulate itself on behalf of the government and in the public interest for that jurisdiction.*
Statutes	*Acts, regulations, bylaws or other instruments established for the purpose of regulation of the practice of professional geoscience in that jurisdiction.*
Stream	*Grouping of science and geoscience educational components designed to cover special requirements for each of the broad areas of geoscience – Geology, Environmental Geoscience and Geophysics.*
Tribunal	*Body created under the legislative act or statutes in a jurisdiction to govern appeals of decisions regarding non-acceptance or delays in acceptances of applicants applying to register as professional geoscientists.*

CONSTITUENT ASSOCIATIONS OF GEOSCIENTISTS CANADA

Association of Professional Engineers and Geoscientists of Alberta
www.apega.ca

Association of Professional Engineers and Geoscientists of British Columbia
www.apeg.bc.ca

Association of Professional Engineers and Geoscientists of the Province of Manitoba
www.apegm.mb.ca

Engineers and Geoscientists New Brunswick
www.apegnb.com

Professional Engineers and Geoscientists Newfoundland and Labrador
www.pegnl.ca

Northwest Territories and Nunavut Association of Professional Engineers and Geoscientists
www.napeg.nt.ca

Geoscientists Nova Scotia
www.geoscientistsns.ca

Association of Professional Geoscientists of Ontario
www.apgo.net

Ordre des Géologues du Québec
www.ogq.qc.ca

Association of Professional Engineers and Geoscientists of Saskatchewan
www.apegs.ca

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