Pre-Health Sciences Pathway to Advanced Diplomas and Degrees Program Standard

The approved program standard for Pre-Health Sciences Pathway to Advanced Diplomas and Degrees program of instruction leading to an Ontario College Certificate delivered by Ontario Colleges of Applied Arts and Technology (MTCU funding code 41599)

Ministry of Advanced Education and Skills Development
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Table of Contents

I. Introduction 1

Development of System-Wide Program Standards 1

Program Standards 1

The Expression of Program Standards as Vocational Learning Outcomes 2

The Presentation of the Vocational Learning Outcomes 2

The Development of a Program Standard 2

Updating the Program Standard 3

II. Vocational Standard 4

Preamble 4

Synopsis of the Vocational Learning Outcomes 5

The Vocational Learning Outcomes 6

III. Essential Employability Skills 13

Context 13

Skill Categories 13

Application and Implementation 14

IV. General Education Requirement 16

Requirement 16

Purpose 16

Themes 17

I. Introduction

This document is the Program Standard for the Pre-Health Sciences Pathway to Advanced Diplomas and Degrees program of instruction leading to an Ontario College Certificate delivered by Ontario colleges of applied arts and technology (MTCU funding code 41599).

Development of System-Wide Program Standards

In 1993, the Government of Ontario initiated program standards development with the objectives of bringing a greater degree of consistency to college programming offered across the province, broadening the focus of college programs to ensure graduates have the skills to be flexible and to continue to learn and adapt, and providing public accountability for the quality and relevance of college programs.

The Program Standards and Evaluation Unit of the Ministry of Advanced Education and Skills Development have responsibility for the development, review and approval of system-wide standards for programs of instruction at Ontario colleges of applied arts and technology.

Program Standards

Program standards apply to all similar programs of instruction offered by colleges across the province. Each program standard for a postsecondary program includes the following elements:

- **Vocational standard** (the vocationally specific learning outcomes which apply to the program of instruction in question),
- **Essential employability skills** (the essential employability skills learning outcomes which apply to all programs of instruction); and
- **General education requirement** (the requirement for general education in postsecondary programs of instruction).

Collectively, these elements outline the essential skills and knowledge that a student must reliably demonstrate in order to graduate from the program.

Individual colleges of applied arts and technology offering the program of instruction determine the specific program structure, delivery methods and other curriculum matters to be used in assisting students to achieve the outcomes articulated in the standard. Individual colleges also determine whether additional local learning outcomes will be required to reflect specific local needs and/or interests.

The Expression of Program Standards as Vocational Learning Outcomes

Vocational learning outcomes represent culminating demonstrations of learning and achievement. They are not simply a listing of discrete skills, nor broad statements of knowledge and comprehension. In addition, vocational learning outcomes are interrelated and cannot be viewed in isolation of one another. As such, they should be viewed as a comprehensive whole. They describe performances that demonstrate that significant integrated learning by graduates of the program has been achieved and verified.

Expressing standards as vocational learning outcomes ensures consistency in the outcomes for program graduates, while leaving to the discretion of individual colleges, curriculum matters such as the specific program structure and delivery methods.

The Presentation of the Vocational Learning Outcomes

The **vocational learning outcome** statements set out the culminating demonstration of learning and achievement that the student must reliably demonstrate before graduation.

The **elements of the performance** for each outcome define and clarify the level and quality of performance necessary to meet the requirements of the vocational learning outcome. However, it is the performance of the vocational learning outcome itself on which students are evaluated. The elements of performance are indicators of the means by which the student may proceed to satisfactory performance of the vocational learning outcome. The elements of performance do not stand alone but rather in reference to the vocational learning outcome of which they form a part.

The Development of a Program Standard

In establishing the standards development initiative, the Government determined that all postsecondary programs of instruction should include vocational skills coupled with a broader set of essential skills. This combination is considered critical to ensuring that college graduates have the skills required to be successful both upon graduation from the college program and throughout their working and personal lives.

A program standard is developed through a broad consultation process involving a range of stakeholders with a direct interest in the program area, including employers, professional associations, universities, secondary schools and program graduates working in the field, in addition to students, faculty and administrators at the colleges themselves. It represents a consensus of

participating stakeholders on the essential learning that all program graduates should have achieved.

Updating the Program Standard

The Ministry of Advanced Education and Skills Development will undertake regular reviews of the vocational learning outcomes for this program to ensure that the Pre-Health Sciences Pathway to Certificates and Diplomas (Ontario College Certificate) Program Standard remains appropriate and relevant to the needs of students and employers across the Province of Ontario. To confirm that this document is the most up-to-date release, please contact the Ministry of Advanced Education and Skills Development at the address or email address noted on the inside cover page.

II. Vocational Standard

All graduates of Pre-Health Sciences Pathway to Advanced Diplomas and Degrees programs have achieved the six vocational learning outcomes (VLOs) listed in the following pages, in addition to achieving the essential employability skills (EES) learning outcomes and meeting the general education (GE) requirement.

Preamble

The Pre-Health Sciences Pathway to Advanced Diplomas and Degrees program is designed to provide students with the core knowledge, skills and abilities fundamental to academic success in health sciences programs, as well as other science-related programs at the advanced diploma or degree level. Students will have the opportunity to develop their knowledge and skills in communications, mathematics, biology, physics (if available), and general and organic chemistry so they are well-prepared for the rigours of their next academic program. In addition, the program provides students with the opportunity to learn about potential careers in the health sciences and identify other programs focusing on the biological or chemical sciences that will enable them to achieve their career objectives. As well, the postsecondary credits students earn could be transferred to other health sciences or science-related programs.

The curriculum has been designed to meet subject specific entrance requirements. It is expected that graduates of Pre-Health Sciences Pathway to Advanced Diplomas and Degrees programs will be eligible to apply for admission to Advanced Diploma or Degree programs, as well as Certificate and Diploma programs within two broad fields: health sciences, as well as general sciences. In addition to being granted admission to health sciences or science-related programs, graduates may also be granted course transfer credits, e.g., courses completed in Pre-Health Sciences Pathway to Advanced Diplomas and Degrees programs can be transferred to a Pre-health Sciences program at another institution, or to a different program at either the same, or another institution.

Although this program offers opportunities for graduates to pursue further education, successful completion of the program does not guarantee entry into any particular health or science program, nor does it guarantee course transfer credits. Prospective students should contact the admissions office at the individual colleges or universities for full details of their program admission requirements and credit transfer opportunities. Students may also take advantage of the resources at ONTransfer.ca[1].

Endnote[1]: The Ontario Council on Articulation and Transfer (ONCAT) maintains the provincial postsecondary credit transfer portal, ONTransfer and the Ontario Postsecondary Transfer Guide (OPTG).

Synopsis of the Vocational Learning Outcomes

Pre-Health Sciences Pathway to Advanced Diplomas and Degrees

The graduate has reliably demonstrated the ability to

1. examine biological concepts, processes and systems of the human body, including genetics and epigenetics, as well as the structure, function and properties of the molecules of life, cells, tissues and organ systems in relation to homeostasis, physical development and health.
2. examine concepts, processes and systems of chemistry, including atomic and molecular structure; quantities in chemical reactions; solutions and solubility; acids and bases; as well as organic chemistry and biochemistry in relation to health and the human body.
3. solve numeric problems and interpret data related to health sciences and other science-related fields using mathematical concepts, including algebra and probability, along with descriptive and inferential statistics.
4. use health sciences and other science-related language and terminology appropriately to communicate clearly, concisely, and correctly in written, spoken, and visual forms.
5. prepare a personal strategy and plan for academic, career and professional development in the health sciences or other science-related fields.
6. investigate health sciences and science-related questions, problems and evidence using the scientific method.

Physics (Optional):

7. examine fundamental physics laws and concepts and their application to health sciences and other science-related fields.

Note: The learning outcomes have been numbered as a point of reference; numbering does not imply prioritization, sequencing, nor weighting of significance.

The Vocational Learning Outcomes

1. The graduate has reliably demonstrated the ability to

   examine biological concepts, processes and systems of the human body, including genetics and epigenetics, as well as the structure, function and properties of the molecules of life, cells, tissues, and organ systems in relation to homeostasis, physical development and health.

Elements of the Performance

- describe the characteristics and organization of life
- explain the principle of complementarity of anatomical structure and physiological function
- distinguish among the structural organization levels of the human body
- describe the structure, properties and formation of biological molecules
- describe the relationship between biological molecules and bodily functioning
- determine the fundamental characteristics of cell structure, function, metabolism and reproduction
- describe the importance of the cell membrane in regulating cellular processes
- describe the general characteristics and function of each of the four major tissue classifications
- describe the structure and basic functions of each human organ and organ system
- explain the interrelationships of the human body systems as they relate to human body development, homeostasis and health.
- describe microbiology fundamentals, including pathogenic microbes, how microbes interact and their relation to disease pathology and immunology
- explain the fundamentals of evolutionary theory, genetics and the genetic and epigenetic regulation of gene expression and silencing
- discuss the human body as an ecosystem

2. The graduate has reliably demonstrated the ability to

examine concepts, processes and systems of chemistry, including atomic and molecular structure; quantities in chemical reactions; solutions and solubility; acids and bases; as well as organic chemistry and biochemistry in relation to health and the human body.

Elements of the Performance

- describe atomic structures and represent the electron configurations of a variety of elements using the conceptual framework of the modern atomic theory (energy levels, shells, the Pauli exclusion principle, Hund's rule and the aufbau principle)
- determine the number of valence electrons and their involvement in the formation of chemical bonds
- characterize bond types in ionic, molecular and metallic substances and relate physical and chemical properties to inter- and intra-molecular forces
- apply the Valence Shell Electron Pair Repulsion (VSEPR) theory to draw molecular shapes that represent spatial characteristics of compounds
- describe quantitative relationships in chemical reactions including the mole concept
- describe and classify organic compounds according to their structure, properties and reactions
- use International Union of Pure and Applied Chemistry (IUPAC) nomenclature
- describe the properties of solutions, the concept of concentration, and the importance of water as the universal solvent
- explain the difference between acids and bases
- analyze energy changes and rates of chemical reactions
- solve qualitative and quantitative problems involving chemical equilibria
- characterize and provide examples for oxidation-reduction reactions
- explain electrochemical processes in selected biological and technical systems
- describe the similarities and differences in structure, physical properties and chemical behaviour of families of organic compounds
- identify the characteristics of chemical changes resulting from a variety of chemical reactions
- explain the concept of isomerism in organic compounds, and how different isomers can have dramatically different properties
- explain the biological, medical and environmental significance of organic compounds
- explain the relationship between chemistry and the health of the human body
- describe the gas laws and the general properties of gases
- describe the structure, properties and reactions of biomolecules

3. The graduate has reliably demonstrated the ability to

solve numeric problems and interpret data related to health sciences and other science-related fields using mathematical concepts, including algebra, and probability, along with descriptive and inferential statistics.

Elements of the Performance

- perform multi-step mathematical operations, including addition, subtraction, multiplication, division, and exponentiation with numbers in their various forms—whole, integers, and rational (fractions and decimal) numbers
- use mental calculation strategies to perform basic arithmetic calculations, estimate approximate answers and to check for correctness of answers
- simplify algebraic expressions using commutative, associative, and distributive properties and by applying the rules of exponents
- convert between US Customary and SI (metric) units of measurement, including length, mass, volume and temperature
- apply significant figure and rounding rules to mathematical calculations
- convert between decimal and scientific notation
- solve a variety of health-care and science-related application questions, including per cents, proportions, and formula substitution
- solve a system of linear equations graphically and algebraically
- solve exponential and logarithmic equations
- determine the theoretical or empirical probability of a simple event or combination of events for discrete sample spaces using the additive and multiplication rules for probability
- distinguish between descriptive and inferential statistics
- distinguish between a population and a sample
- explain the role of data in statistical studies and the importance of ensuring data measurement is reliable and valid
- construct, interpret, and analyze statistical tables and graphical summaries
- determine statistical measures of central tendency and variation for numerical and graphical data and interpret the result
- distinguish between discrete and continuous probability distributions
- describe the key features of the standard normal distribution
- calculate probabilities and values using the normal distribution table and apply normal distribution and the central limit theorem to health care situations
- estimate the confidence interval for means and proportions

4. The graduate has reliably demonstrated the ability to

   use health sciences and other science-related language and terminology appropriately to communicate clearly, concisely, and correctly in written, spoken, and visual forms.

Elements of the Performance

- use and cite scholarly health sciences sources, such as peer-reviewed publications, academic journals and government documents for report writing
- prepare health sciences-related diagrams, reports and presentations according to current health sciences standards and practices (e.g., American Psychological Association [APA] style)
- use grammar, spelling, and punctuation correctly to produce clear, concise professional and academic communications
- use appropriate and relevant scientific terminology, abbreviations, acronyms and units of measure
- prepare and present health sciences information clearly and concisely using oral, written, diagrammatic and electronic formats that suit the intended purpose and audience
- use Information and Communications Technologies (ICT) (such as mobile and wireless communication devices) to transmit text, voice, video and data in an professional manner
- communicate with others in a respectful and collaborative manner
- reframe spoken and written messages to clarify the intentions and/or expectations of others

5. The graduate has reliably demonstrated the ability to

prepare a personal strategy and plan for academic, career and professional development in the health sciences or other science-related fields.

Elements of the Performance

- investigate educational requirements and opportunities for employment in health sciences and science-related fields
- Identify the roles and benefits of, and requirements for, acquiring professional designations and certification in the health sciences
- investigate training and certification to enhance employment opportunities in the health sciences, e.g., Cardiopulmonary Resuscitation (CPR), First Aid, anaphylaxis training, Workplace Hazardous Materials Information System (WHMIS)
- investigate ways to resource further educational and training opportunities in the health sciences and/or other science-related fields
- investigate and adopt strategies to keep pace with, and adapt to changing workforce demands and trends in the health sciences
- investigate and adopt strategies to stay informed of advances in best practices and technology in the health sciences
- describe the purpose of health sciences professional associations and organizations at the community, regional, provincial and national levels
- discuss ways to develop a professional network and how to get involved with relevant professional associations and activities
- develop a strategy to build up and maintain personal effectiveness and a healthy academic-work-life balance
- develop and implement a personal academic learning and career plan

6. The graduate has reliably demonstrated the ability to

investigate health sciences and science-related questions, problems and evidence using the scientific method.

Elements of the Performance

- describe the main types of scientific research designs, including qualitative and quantitative research methods
- discuss issues and controversies surrounding scientific research, including ethical considerations
- describe the main stages of the research process, e.g., conducting a scientific literature review, formulating a statement of the research problem, designing the research method, analysing and interpreting the data, and reporting results
- determine the relevance of scientific information from a variety of current and reliable sources
- identify and critically evaluate opposing positions on health and science issues
- formulate research questions by defining a problem, developing a hypothesis and making predictions
- investigate science questions using appropriate scientific techniques
- test a hypothesis by gathering, organizing and documenting research data; analyzing the results; and determining if the results support the hypothesis
- portray scientific data using statistical methods, graphs, charts, tables and appropriate statistical language
- use scientific reasoning to draw conclusions that explain investigation results
- report on the objectives, methods, results and conclusions of scientific investigations
- discuss the personal, ethical, sociocultural, economic and environmental impacts of the changes being brought about by biological and chemical research

The Vocational Learning Outcomes

VLO 7 is a physics option specific to Pre-Health Sciences Pathway to Advanced Diplomas and Degrees programs (MTCU Code 41599). Graduates of these programs have reliably demonstrated Vocational Outcomes 1-6, in addition to VLO 7.

7. The graduate has reliably demonstrated the ability to

   examine fundamental physics laws and concepts and their application to health sciences and other science related fields.

Elements of the Performance

- examine and solve numerical physics problems using applicable mathematical concepts
- describe physical properties using appropriate units of measure
- select and use relevant information to solve physics problems
- interpret graphical representations of physics concepts and data
- discuss and apply the foundational concepts of mechanics, such as Newton's Three Laws of Motion, one-dimensional kinematics, principles of work, energy and power and the Law of Conservation of Energy
- discuss and apply the foundational concepts of matter, such as the characteristics of solids, liquids and gases, principles of temperature and heat, laws of thermodynamics, and fluid mechanics
- discuss and apply the foundational concepts of electricity, magnetism, and waves, such as nuclear forces and radioactivity, the principles of electromagnetism, the properties of magnetic fields, the distinction between alternating and direct current, the properties of mechanical waves and sound
- relate physics concepts to everyday phenomena, with a focus on the human body and the health sciences

III. Essential Employability Skills

All graduates of the Pre-Health Sciences Pathway to Advanced Diplomas and Degrees program of instruction must have reliably demonstrated the essential employability skills learning outcomes listed on the following pages, in addition to achieving the vocational learning outcomes and meeting the general education requirement.

Context

Essential Employability Skills (EES) are skills that, regardless of a student's program or discipline, are critical for success in the workplace, in day-to-day living and for lifelong learning.

The teaching and attainment of these EES for students in, and graduates from, Ontario's colleges of applied arts and technology are anchored in a set of three fundamental assumptions:

- these skills are important for every adult to function successfully in society today;
- our colleges are well equipped and well positioned to prepare graduates with these skills;
- these skills are equally valuable for all graduates, regardless of the level of their credential, whether they pursue a career path, or they pursue further education.

Skill Categories

To capture these skills, the following six categories define the essential areas where graduates must demonstrate skills and knowledge.

- Communication
- Numeracy
- Critical Thinking & Problem Solving
- Information Management
- Interpersonal
- Personal

Application and Implementation

In each of the six skill categories, there are a number of defining skills, or sub skills, identified to further articulate the requisite skills identified in the main skill categories. The following chart illustrates the relationship between the skill categories, the defining skills within the categories and learning outcomes to be achieved by graduates from all postsecondary programs of instruction that lead to an Ontario College credential.

EES may be embedded in General Education or vocational courses, or developed through discrete courses. However these skills are developed, all graduates with Ontario College credentials must be able to reliably demonstrate the essential skills required in each of the six categories.

Skill Category	**Defining Skills:** Skill areas to be demonstrated by graduates:	**Learning Outcomes:** The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:
Communication	• Reading • Writing • Speaking • Listening • Presenting • Visual literacy	1. communicate clearly, concisely and correctly in the written, spoken and visual form that fulfills the purpose and meets the needs of the audience. 2. respond to written, spoken or visual messages in a manner that ensures effective communication.
Numeracy	• Understanding and applying mathematical concepts and reasoning • Analyzing and using numerical data • Conceptualizing	1. execute mathematical operations accurately.
Critical Thinking & Problem Solving	• Analyzing • Synthesizing • Evaluating • Decision making • Creative and innovative thinking	1. apply a systematic approach to solve problems. 2. use a variety of thinking skills to anticipate and solve problems.

Skill Category	**Defining Skills:** Skill areas to be demonstrated by graduates:	**Learning Outcomes:** The levels of achievement required by graduates. The graduate has reliably demonstrated the ability to:
Information Management	• Gathering and managing information • Selecting and using appropriate tools and technology for a task or a project • Computer literacy • Internet skills	1. locate, select, organize and document information using appropriate technology and information systems. 2. analyze, evaluate and apply relevant information from a variety of sources.
Interpersonal	• Teamwork • Relationship management • Conflict resolution • Leadership • Networking	1. show respect for the diverse opinions, values, belief systems and contributions of others. 2. interact with others in groups or teams in ways that contribute to effective working relationships and the achievement of goals.
Personal	• Managing self • Managing change and being flexible and adaptable • Engaging in reflective practices • Demonstrating personal responsibility	1. manage the use of time and other resources to complete projects. 2. take responsibility for one's own actions, decisions and their consequences.

IV. General Education Requirement

All graduates of the Pre-Health Sciences Pathway to Advanced Diplomas and Degrees program must have met the general education requirement described on the following pages, in addition to achieving the vocational and essential employability skills learning outcomes.

Requirement

The General Education Requirement for programs of instruction is stipulated in the Credentials Framework (Appendix A in the Minister's Binding Policy Directive Framework for Programs of Instruction).

In programs of instruction leading to either an Ontario College Diploma or an Ontario College Advanced Diploma, it is required that graduates have been engaged in learning that exposes them to at least one discipline outside their main field of study and increases their awareness of the society and culture in which they live and work. This will typically be accomplished by students taking 3 to 5 courses (or the equivalent) designed discretely and separately from vocational learning opportunities.

This general education learning would normally be delivered using a combination of required and elective processes.

Purpose

The purpose of General Education in the Ontario college system is to contribute to the development of citizens who are conscious of the diversity, complexity and richness of the human experience; who are able to establish meaning through this consciousness; and who, as a result, are able to contribute thoughtfully, creatively and positively to the society in which they live and work.

General Education strengthens students' essential employability skills, such as critical analysis, problem solving and communication, in the context of an exploration of topics with broad-based personal and/or societal importance.

Themes

The themes listed below will be used to provide direction to colleges in the development and identification of courses that are designed to fulfil the General Education Requirement for programs of instructions.

Each theme provides a statement of Rationale and offers suggestions related to more specific topic areas that could be explored within each area. These suggestions are neither prescriptive nor exhaustive. They are included to provide guidance regarding the nature and scope of content that would be judged as meeting the intent and overall goals of General Education.

1. Arts in Society:

Rationale:

The capacity of a person to recognize and evaluate artistic and creative achievements is useful in many aspects of his/her life. Since artistic expression is a fundamentally human activity, which both reflects and anticipates developments in the larger culture, its study will enhance the student's cultural and self-awareness.

Content:

Courses in this area should provide students with an understanding of the importance of visual and creative arts in human affairs, of the artist's and writer's perceptions of the world and the means by which those perceptions are translated into the language of literature and artistic expression. They will also provide an appreciation of the aesthetic values used in examining works of art and possibly, a direct experience in expressing perceptions in an artistic medium.

2. Civic Life:

Rationale:

In order for individuals to live responsibly and to reach their potential as individuals and as citizens of society, they need to understand the patterns of human relationships that underlie the orderly interactions of a society's various structural units. Informed people will have knowledge of the meaning of civic life in relation to diverse communities at the local, national and global level and an awareness of international issues and the effects of these on Canada, as well as Canada's place in the international community.

Content:

Courses in this area should provide students with an understanding of the

meaning of freedoms, rights and participation in community and public life, in addition to a working knowledge of the structure and function of various levels of government (municipal, provincial, national) in a Canadian and/or in an international context. They may also provide an historical understanding of major political issues affecting relations between the various levels of government in Canada and their constituents.

3. Social and Cultural Understanding:

Rationale:

Knowledge of the patterns and precedents of the past provide the means for a person to gain an awareness of his or her place in contemporary culture and society. In addition to this awareness, students will acquire a sense of the main currents of their culture and that of other cultures over an extended period of time in order to link personal history to the broader study of culture.

Content:

Courses in this area are those that deal broadly with major social and cultural themes. These courses may also stress the nature and validity of historical evidence and the variety of historical interpretation of events. Courses will provide the students with a view and understanding of the impact of cultural, social, ethnic or linguistic characteristics.

4. Personal Understanding:

Rationale:

Educated people are equipped for life-long understanding and development of themselves as integrated physiological and psychological entities. They are aware of the ideal need to be fully functioning persons: mentally, physically, emotionally, socially, spiritually and vocationally.

Content:

Courses in this area will focus on understanding the individual: his or her evolution; situation; relationship with others; place in the environment and universe; achievements and problems; and his or her meaning and purpose. They will also allow students the opportunity to study institutionalized human social behaviour in a systematic way. Courses fulfilling this requirement may be oriented to the study of the individual within a variety of contexts.

Science and Technology:

Rationale:

Matter and energy are universal concepts in science, forming a basis for understanding the interactions that occur in living and non-living systems in our universe. Study in this area provides an understanding of the behaviour of matter that provides a foundation for further scientific study and the creation of broader understanding about natural phenomena.

Similarly, the various applications and developments in the area of technology have an increasing impact on all aspects of human endeavour and have numerous social, economic and philosophical implications. For example, the operation of computers to process data at high speed has invoked an interaction between machines and the human mind that is unique in human history. This and other technological developments have a powerful impact on how we deal with many of the complex questions in our society.

Content:

Courses in this area should stress scientific inquiry and deal with basic or fundamental questions of science rather than applied ones. They may be formulated from traditional basic courses in such areas of study as biology, chemistry, physics, astronomy, geology or agriculture. As well, courses related to understanding the role and functions of computers (e.g., data management and information processing) and assorted computer-related technologies should be offered in a non-applied manner to provide students with an opportunity to explore the impact of these concepts and practices on their lives.