Technological and Scientific Experimentation

Prework Training
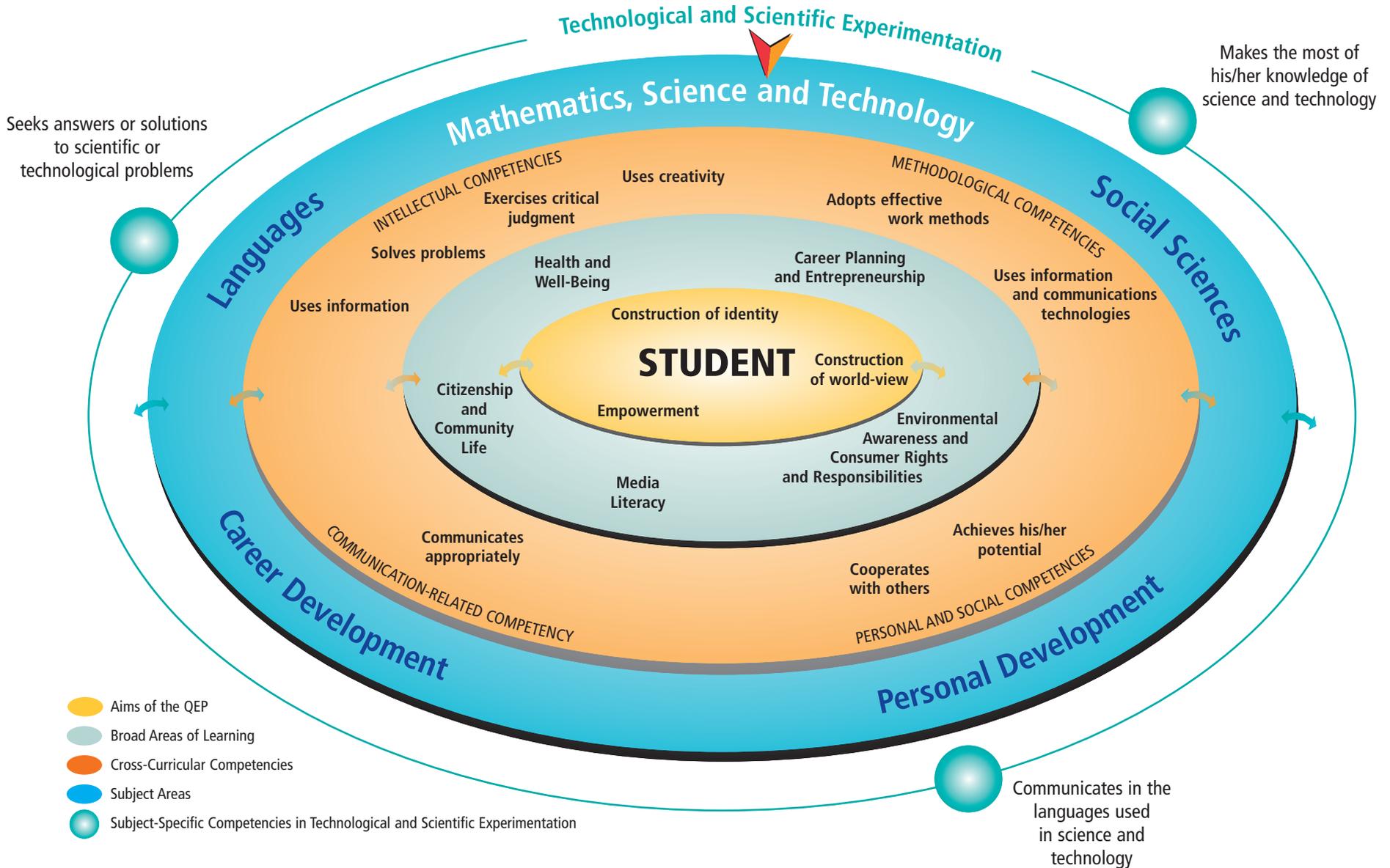
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Introduction to the Program

Science and technology have made a key contribution to the transformation of society. They can be found everywhere, be it in the multiplicity of objects that make up our everyday environment or in the many different spheres of human activity. While the aim of science is to describe, explain and, at times, predict phenomena, technology is a means of meeting a variety of needs using objects, systems or products. Imagination and the desire to discover are just as much a part of scientific and technological activities as is the need to understand and explain. In this regard, the field of science and technology is not the preserve of a small group of experts; rather, it should be accessible to all students, regardless of the difficulties some of them may have had in the past. In order to motivate students enrolled in Prework Training, teachers should take advantage of their curiosity about the phenomena around them and their interest in inventions and scientific and technological innovation. It is also important to offer opportunities for real-life everyday applications.

The field of science and technology is not the preserve of a small group of experts; rather, it should be accessible to all students, regardless of the difficulties some of them may have had in the past.

The Technological and Scientific Experimentation program covers a range of situations that enable students to find answers to questions about their everyday environment; to create, understand and handle technological tools; and to understand how certain scientific discoveries or technological innovations have helped improve living conditions at home, at school and in the workplace. The program adopts a holistic and systemic approach to science and technology and emphasizes their interdependence rather than their differences.

Given the rapid pace of scientific and technological developments, students must learn to adapt to change, such as the proliferation of new products on the market, the growing role of computers in most jobs and stricter occupational health and safety rules. They will need to be able to adapt throughout their lifetime, and school plays an important role in preparing them to do so. To this end, it is essential that the school collaborate with different partners: businesses, industries, training centres and other community resources (e.g. museums, gardens, science clubs). This collaboration will enable students to develop their competencies in science and technology at school and beyond.

Students will build on and consolidate the learning acquired in previous cycles in achievement contexts based on real-life situations. The problems presented are related to the broad areas of learning and a variety of fields (astronomy, biology, chemistry, geology, physics and technology) grouped together in four major areas: The Material World, The Living World, The Earth and Space, and The Technological World. The learning content is based on the concerns and interests of students enrolled in Prework Training and is sufficiently varied to take into account their needs, the resources available in different communities and regional characteristics. The variety of topics should enable each student to acquire the basic tools needed to develop autonomy, participate in society and enter the job market. They include an understanding of the human body and health issues, food preservation, environmental protection, the various phenomena that affect the planet and the multiplicity of technological achievements.

The program targets three competencies:

– Seeks answers or solutions to scientific or technological problems

– Makes the most of his/her knowledge of science and technology

– Communicates in the languages used in science and technology

Making Connections: Technological and Scientific Experimentation and the Other Subjects in Prework Training

To ensure integrated training, it is important to consider the learning acquired in the Technological and Scientific Experimentation program in conjunction with the learning acquired in the other subject areas. This program will benefit from the contribution of the other subjects, and enrich them as well. Since students will be entering the work force in the short term, it is important to help them understand the connections between the competencies targeted by this program and those they will be developing in all of the subject areas.

Students who undertake an experimental approach are often required to use their mathematical learning to measure, count, calculate averages, visualize objects in space and select different means of representation. Mathematics is also essential in designing, maintaining and repairing technical objects and technological systems. With its vocabulary, graphics, notation and symbols, this subject offers students a precise and flexible language they can use. In turn, the Technological and Scientific Experimentation program provides concrete examples of certain particularly difficult mathematical concepts.

Practically speaking, students should be encouraged to make connections between the subject-specific competencies and different jobs.

Languages provide the tools necessary to develop the competencies associated with this program. The learning acquired in reading and writing is essential for appropriately interpreting information and for explaining how a technical object works. Important connections can also be made with the Physical Education and Health Program by addressing, for example, the development of different types of sports equipment and its impact on performance.

Practically speaking, students should be encouraged to make connections, either in simulated work situations in the school workshop or in actual situations in a practicum setting, between the activities offered in the technological and scientific experimentation courses and the different job functions they will be learning. Consider, for example, the use of a forklift, a cash register or a scale. Similarly, it might be useful to address the importance of new technologies with a view to improving certain working conditions.

Pedagogical Context

Teachers play an important role in helping students enrolled in Prework Training develop competencies in science and technology. They must be both rigorous and flexible, while ensuring that students are not overwhelmed by the amount of information involved. To this end, they must present open-ended situations associated with a realistic task and provide students with the necessary resources. In order to ensure consistency, teachers should encourage students to ask questions, taking into account the aspects of the method they wish to have them concentrate on (e.g. formulating a preliminary explanation, applying the concept of measurement, presenting results). As needed, they provide appropriate explanations to help the students progress and analyze their mistakes. Finally, they ensure that the students follow lab and workshop safety rules.

Students will learn more about analyzing data, information, objects or technological systems in situations that are familiar to them.

In Secondary Cycle One, the students were introduced to certain scientific and technological approaches. They became familiar with several elements of the program content. In Prework Training, the teacher will help them pursue their learning, focusing more particularly on how they can use it to meet their personal and work-related needs. He or she will encourage them to pay attention to the interdependent relationship between their scientific and technological knowledge on the one hand, and their preparation for the job market on the other. To this end, he or she will rely on each student's learning.

Teachers may choose to focus on one competency at a time or on any combination of the three. To help students seek answers or solutions to scientific or technological problems, they will present problem-solving situations involving hands-on activities and requiring the use of various methods (e.g. experimental, observational, technological design).

To help students learn how to make the most of their knowledge of science and technology, teachers will present problems related to everyday situations. In a complex scientific or technological problem, they will assign different tasks to meet each student's needs. They will also use a variety of pedagogical strategies, such as the problem-solving approach, case studies or the project-based approach, to help students learn to solve problems of varying complexity and to reflect on their approach. Students will learn more about analyzing data, information, objects or technological systems in situations that they are familiar with. Teachers should also provide their students with frequent opportunities to formulate opinions about scientific and technological problems.

Finally, to help students communicate in the languages used in science and technology, teachers will introduce learning and evaluation situations that enable them to select an appropriate method of presentation, integrate appropriate scientific and technological terms into their oral and written language, and make connections between concepts and the various ways of representing them graphically or symbolically.

Focus of the Competency

The competency *Seeks answers or solutions to scientific or technological problems* involves the assimilation of an experimental method based on observation, which enables students to address abstract concepts in an active and practical manner, and a technological design process, which also involves an active approach. Thus, students are encouraged to ask questions and solve problems by observing, handling, measuring, constructing or experimenting in a multipurpose room, the lab or the real world.

In previous cycles, students learned to propose scientific and technological solutions to problems. They became familiar with safety rules and instructions. In Prework Training, students continue to develop this competency with a view to acquiring life and work skills. The scientific problems addressed will therefore be directly related to everyday phenomena, such as water contamination, or to the world of work, such as the proper use of household products. Learning and evaluation situations in technology should enable students to learn to build or modify objects to meet a personal need, for example, to rewire a sound system to obtain better sound, or to improve the storage capacity of a locker at school or a closet at home.

In this program, students should apply a scientific method in a learning situation that enables them to identify, understand and explain a simple, concrete problem. By asking questions, they seek meaningful clues, attempting to determine what they need to formulate hypotheses. With the teacher's help, they perform an experiment, for example on food preservation (determining the effect of temperature on meat preservation) or the minimum force required for a given task (measuring the effect of using a system of levers or pulleys). Given the results obtained, they can validate their hypotheses and make adjustments to their approach.

The students observe, perform hands-on activities, build and conduct experiments in a multipurpose room or lab.

In the technological design process, students must first consider different scenarios, taking into account certain constraints, requirements and the means available. They must then select a scenario and implement it. Through trial and error and with the teacher's help, they can verify their initial solution. If applicable, they revise their procedure and suggest improvements.

The following diagram illustrates the dynamics involved in seeking answers or solutions to scientific or technological problems. The feedback arrows indicate that the sequence is not necessarily linear, and students' ability to question their work is essential since they learn from their mistakes through trial and error. It is also possible to switch from one process to the other, for example, when conducting an experiment to determine which material should be used in designing a technical object. Similarly, the inquiry process can be facilitated by the individual or group design of a technical object, such as a measuring instrument.

The competency *Seeks answers or solutions to scientific or technological problems* has four key features: Defines a problem; Chooses an investigation or design scenario; Carries out the procedure; and Considers his/her results or solution.

Key Features of Competency 1

Defines a problem

Identifies the scientific or technological characteristics of the problem • Recognizes the elements that seem relevant • Reformulates the problem

Chooses an investigation or design scenario

Considers different scenarios • Takes into account the constraints associated with each scenario • Chooses what he/she thinks is the best scenario for achieving the goal in question • Justifies his/her choices • Plans his/her procedure

Seeks answers or solutions to scientific or technological problems

Considers his/her results or solution

Examines the results in light of the procedure used • Suggests improvements, if applicable • Draws conclusions

Carries out the procedure

Follows the steps in the plan • If necessary, adjusts his/her tests, reviews his/her plan and looks for a new way of solving the problem • Takes note of any useful detail or observation

Learning Targets

At the end of the program, students can describe certain aspects of an everyday problem (e.g. water contamination), a problem related to the world of work (e.g. using simple machines) or a problem involving a personal need (e.g. taking care of a skateboard).

With regard to the scientific process, students can identify, understand and explain a simple, concrete problem. They can conduct an experiment. They present the results obtained and propose explanations or solutions to the questions raised. They adjust their approach where necessary.

As for the technological design process, students consider a few scenarios, taking into account certain constraints and the means available. They select and implement a scenario. They test their solution. They revise their approach and, if necessary, suggest improvements.

They demonstrate openness, rigour and safety when dealing with scientific and technological questions.

Evaluation Criteria

– Understanding of the situation
– Development of a suitable procedure for the situation
– Implementation of the procedure
– Development of conclusions, explanations or solutions

Focus of the Competency

For students enrolled in Prework Training, the competency *Makes the most of his/her knowledge of science and technology* applies for the most part to everyday situations. Students learn different concepts in order to explain natural phenomena, understand how technical objects work and maintain them. They could, for example, study the influence of the seasons on various work-related activities, the importance of planting periods in horticulture or the making of artificial snow by ski resorts. They could also consider water filtration and the use of various products for swimming pool maintenance, how to maintain and repair lawn mowers, etc.

These concepts are tools that will help them to understand the world in which they live and to make enlightened decisions in various situations. Students become aware of the evolution of scientific and technological knowledge and are encouraged to reflect on its environmental, economic and social impact.

In Secondary Cycle One, the students studied natural phenomena, current events, everyday problems and major issues of the day. Whether in terms of science or technology, they recognized the advantages and disadvantages of a situation in order to identify its impact, particularly on the environment, and the related ethical questions, for example, the consequences of discharging various products such as waste oil, paint and liquid manure in our waterways.

Students learn different concepts in order to explain natural phenomena, understand how technical objects work and maintain them.

In Prework Training, students will need to apply their knowledge to other contexts, and the teacher should help them realize that the job market is a good opportunity to do so. Consider, for example, the danger involved in mixing cleaning products or storing them inappropriately, or the recovery and recycling of domestic and industrial waste. The students will thus be encouraged to briefly analyze different situations from a scientific and technological perspective.

The competency *Makes the most of his/her knowledge of science and technology* has three key features: Identifies the effects of science and technology; Understands how technical objects work; and Understands natural phenomena.

Identifies the effects of science and technology

Recognizes certain effects of science and technology on individuals, society, the environment and the economy • Places these effects in their social and historical context and examines their impact on people's lifestyle • Studies ethical questions or issues associated with these effects

Understands how technical objects work

Demonstrates curiosity about certain technical objects • Examines how they work and how they are made • Takes them apart, if necessary • Identifies the materials, parts and different types of links in these technical objects • Illustrates them in a schematic diagram • Recognizes the different systems and subsystems • Explains how they work • Does maintenance or repairs, if necessary

Makes the most of his/her knowledge of science and technology

Understands natural phenomena

Is curious about his/her environment • Examines certain phenomena • Describes them qualitatively • Explains phenomena using models • Becomes familiar with the relevant concepts and, if applicable, recognizes that they evolve

By the end of the program, the students can apply some of their knowledge of science and technology in the appropriate contexts, especially with respect to the world of work (e.g. the recycling of industrial waste). They briefly analyze different situations from a scientific and technological perspective.

When students briefly analyze a situation from a scientific point of view, they observe the phenomenon in question and identify certain properties. They propose explanations or tentative solutions and then verify them on the basis of scientific concepts, laws, theories and models.

When students briefly analyze a situation from a technological point of view, they observe the technical object and identify how it works. They handle the object and, if necessary, take it apart to understand its main systems and mechanisms. They describe the operating principles of the object using scientific and technological concepts. They explain the solutions they chose for making the object and, if necessary, do maintenance or repairs.

Where applicable, students study the advantages and disadvantages of different solutions. They identify possible consequences of their decision for individuals, society, the environment and the economy.

Evaluation Criteria

– Formulation of appropriate questions

– Appropriate use of scientific and technological concepts and models

– Relevant explanations or solutions

– Identification of certain effects of science and technology on human beings and their environment

COMPETENCY 3 Communicates in the languages used in science and technology

Focus of the Competency

Communication plays an essential role in the construction of scientific and technological knowledge. It follows certain rules, such as the use of scientific language that is understood by a particular community and, through discussion, promotes the verification of constructed knowledge. It must sometimes be adapted to the audience, thereby helping to develop precision, rigour and accuracy.

The competency *Communicates in the languages used in science and technology* is developed in situations in which students share with classmates their understanding of certain phenomena as well as the means they used to arrive at this understanding. In research and experimentation activities, they are encouraged to use scientific and technological language as much as possible. They are also encouraged to use tables, graphs, symbols, diagrams, technical drawings and scale models in their presentations, provided they follow mathematical, scientific and technological conventions. Information and communications technologies, such as spreadsheet software, graphic organizers, ideas managers and 2D and 3D software, may also prove useful and provide opportunities for enrichment.

Students share with classmates their understanding of certain phenomena and explain the methods they used to achieve this understanding.

In elementary school, students used different elements of scientific and technological language to formulate questions, explain methods, describe objects and illustrate how they work. In Secondary Cycle One, they interpreted and produced oral, written or visual scientific and technological messages. They will now use their knowledge of science and technology to explain everyday situations or phenomena and to present concepts associated with the handling of certain products or the use of technologies found in different workplaces. For example, they will be able to decipher a drawing in order to assemble various objects.

This competency is inextricably linked to the other two competencies in the program and cannot be developed in isolation from them. It has three key features: Participates in exchanging scientific and technological information; Interprets scientific and technological messages; and Produces and shares scientific and technological messages.

Participates in exchanging scientific and technological information

Understands the usefulness of information sharing • Is open to other points of view • Compares his/her procedure with that of other people • Validates his/her point of view or solution

Interprets scientific and technological messages

Makes sure his/her sources are credible • Finds relevant information • Makes connections between concepts and their various graphic or symbolic representations • Identifies the meaningful elements of the message

Communicates in the languages used in science and technology

Produces and shares scientific and technological messages

Takes the target audience and context into account • Structures his/her message • Selects words, expressions, symbols and graphics • Uses the appropriate ways of presenting information • Demonstrates rigour and coherence

By the end of the program, students can actively exchange scientific and technological information. They can share their understanding of certain phenomena and the means they used to achieve this understanding.

They interpret, produce or transmit oral, written or visual scientific or technological messages drawn from real-life situations. They explain in everyday language the meaning of the messages they interpreted, produced or transmitted. They use their knowledge of science and technology to explain everyday situations or phenomena.
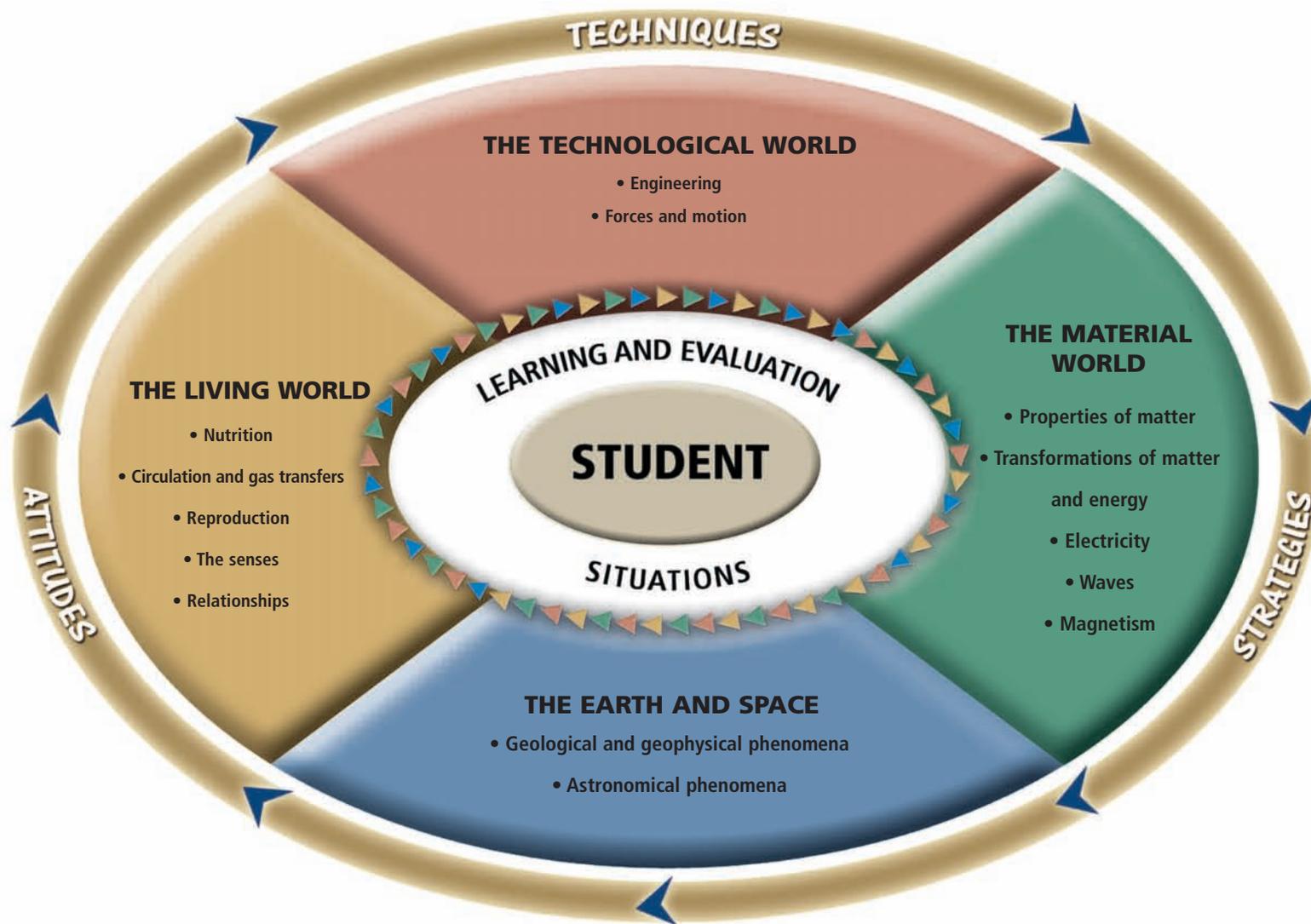
Evaluation Criteria

– Active participation in information sharing

– Accurate interpretation of scientific and technological messages

– Appropriate production or transmission of scientific and technological messages

– Use of appropriate scientific and technological terminology, rules and conventions in the production of messages

Program Content

The job market provides a number of scientific and technological challenges, and students enrolled in Prework Training should be aware of them. The Technological and Scientific Experimentation program offers a set of resources comprising concepts, strategies, techniques and attitudes in different learning and evaluation situations. The teacher may select the elements that meet students' specific needs, based on their environment and, in particular, on the economic activity in the region.

The following diagram illustrates the general structure of the program content, which is divided into two parts. The first set of tables groups the concepts together in four major areas: The Material World, The Living World, The Earth and Space, and The Technological World. The program content was organized in this way to make it easier for teachers to identify the key concepts that students should learn. These areas should not be examined separately or sequentially. The concepts should be covered in integrated learning and evaluation situations. Each area is presented in a four-column table: General Concepts, Orientations, Specific Concepts and Cultural References.

The second set of tables lists strategies, techniques and attitudes. As important as the concepts, these content elements play a crucial role in competency development.

Work-Oriented Training Path, Prework Training

STRUCTURE OF THE PROGRAM CONTENT

TECHNIQUES

THE TECHNOLOGICAL WORLD
- Engineering
- Forces and motion

THE MATERIAL WORLD
- Properties of matter
- Transformations of matter and energy
- Electricity
- Waves
- Magnetism

THE LIVING WORLD
- Nutrition
- Circulation and gas transfers
- Reproduction
- The senses
- Relationships

LEARNING AND EVALUATION

STUDENT

SITUATIONS

THE EARTH AND SPACE
- Geological and geophysical phenomena
- Astronomical phenomena

ATTITUDES

STRATEGIES

The Material World

Knowledge of the material world enables students to take a different view of the substances and materials found in their environment. In studying the properties of matter and the changes it undergoes, students can understand their usefulness and the importance of safety rules.

The Material World			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**
Properties of matter	Several commercial products (e.g. detergents, pesticides, paints, solvents, aerosols, metals, oils) can be found at school, at home or in the workplace. Inappropriate use of these products can result in serious consequences and health problems. Safety pictograms on the products help us classify them (flammable, corrosive, toxic) and take the necessary precautions when using them. Some products are incompatible (e.g. chlorine bleach and ammonia) and precautions must be taken when storing and disposing of them in order to reduce the risk of injury. Acidity and alkalinity (basicity) are properties of several liquids. The pH scale is used to measure the degree of acidity of a product and to classify it (e.g. as a strong base or a weak acid). The pH level can be measured using coloured indicators (litmus) in solution or in strips. The concept of pH is applied in a number of sectors of activity (e.g. pool maintenance, greenhouses, cosmetics). Where facilities are available, substances and materials can be recycled. Society has everything to gain by recovering and reusing paper, metal, plastics and other materials rather than allowing them to accumulate in the environment.	– Categories of commercial products – Safety pictograms – Acidity/alkalinity (pH scale) – Recyclable materials	*Environment* – Acid precipitation *Applications* – WHMIS[1] – Labelling of household products – Separate collection

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1. Workplace Hazardous Materials Information System. See the Web site of the Commission de la santé et de la sécurité du travail (CSST).

The Material World			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**

Transformations of matter and energy	Influenced by certain factors, substances and materials undergo changes. Some of these changes occur naturally, but it is also possible to affect these changes. Bending, moulding, preparing or separating mixtures (filtration, decantation) and phase changes (solidification, boiling) are all examples of physical changes.
	
	Chemical changes involve transformations to the nature of the initial substances. Rust (oxidation) can be delayed using rustproofing paint. The fire triangle represents the three factors necessary for combustion: fuel (gas, wood), an oxidizing agent (oxygen, chlorine) and heat. Firefighters attempt to eliminate one of these three factors in order to put out a fire.
	
	Composting is a form of chemical recycling that uses fermentation to break down kitchen waste, changing it into compost that can be used to fertilize plants. There are several ways of obtaining compost, helping to reduce the quantity of household garbage.
	
	Heat is often produced during these changes. By limiting heat exchange with the surrounding environment, thermal insulation makes it possible to keep liquids hot, limit water heater energy loss, prevent ice from forming and preserve foods.
		– Physical changes
		  • Phase changes
		  • Deformation
		  • Mixtures, solutions and alloys
		– Chemical changes
		  • Oxidation
		  • Combustion
		  (fire triangle)
		  • Composting
		– Thermal insulation
			Applications
			– Food processing
			– Fire prevention
			– Fighting forest fires
			Society
			– Water treatment

Electricity	Electrical charges can appear on certain neutral materials after they are rubbed with other materials. These charges are either positive or negative, and produce an electrical field. They attract when they are of opposite signs and repel when they are of the same sign.	– Types of electrical charges
		  • Positive and negative charges
		  • Forces of attraction and repulsion
		  • Electrical field
			Applications
			– Lighting systems
			– Communications systems (e.g. television, sound system, radio)
			– Heating systems

The Material World			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**
Waves	Light phenomena are an everyday occurrence: reflections in a mirror; refraction producing a deformed image of objects under water or under a magnifying glass; dispersion; shadow. The electromagnetic spectrum includes various ranges of radiation, of which white (or visible) light is only one part. These waves differ in terms of the energy they carry and their ability to penetrate matter. The different categories of radiation (radio waves, microwaves, infrared, visible light, ultraviolet, X-rays and gamma rays) have numerous applications in everyday life.	– Light (shadow, reflection, refraction, dispersion) – Electromagnetic spectrum	– Environment – Natural radioactivity *Applications* – Sunscreen – Telecommunications (e.g. cell phones, satellites)
Magnetism	Some objects have the property of attracting iron, cobalt and nickel, or alloys of these metals. Whether natural or artificial, magnets have a magnetic field and two poles: north and south. Different poles attract, while similar poles repel.	– Magnets – Poles – Attraction, repulsion	– Environment – Earth's magnetic field *Applications* – Compass – Speaker

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The Living World

In studying the human body, the students will come to realize that the survival of living organisms is made possible by the functions of nutrition, respiration and reproduction. They will understand how their sense organs provide information about the environment and enable them to relate and adapt to it. They will observe that the survival of living organisms and the quality of their physical surroundings are closely linked to human activity. Finally, they will learn to respect other living species and to act in an environmentally responsible manner.

The Living World			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**
Nutrition	Nutrition helps ensure physical well-being and provide the energy required to carry out everyday activities. A healthy, balanced diet is essential to human growth and development. Food is processed in four stages (ingestion, digestion, absorption and elimination) as it makes its way through the digestive system, where it undergoes mechanical and chemical changes. The digestive tract and the other organs involved in the process play an important role, as do the digestive glands, such as the liver and pancreas.	– Types of foods (water, protein, carbohydrates, fats, vitamins, minerals) – Digestive tract (mouth, esophagus, stomach, small intestine, large intestine) – Processing (mechanical and chemical changes)	*Physical and mental health* – Drugs and poisons – Vitamins and supplements – Healthy, balanced diet *Applications* – Food preservation – Genetically modified organisms (GMOs)

Circulation and gas transfers	The transportation (respiratory and circulatory) systems, which allow organisms to exchange substances and energy with their environment, are essential for sustaining life. Oxygen and carbon dioxide are transported by the circulatory system through different types of blood vessels. Healthy circulatory and respiratory systems help the heart and blood vessels stay healthy and reduce the risk of cardiovascular disease.
	The excretory system filters the blood by evacuating cell waste and producing urine. It plays a crucial role in maintaining an internal balance.
		– Respiratory system (nasal cavities, larynx, trachea, bronchi, lungs)
		– Circulatory system (heart, veins and arteries, types of blood vessels)
		– Excretory system (kidneys, ureters, bladder, urethra)
			Physical and mental health
			– Cardiopulmonary resuscitation (CPR)
			
			Environment
			– Air quality
			  • Automobile and industrial pollution
			  • Smoking

Reproduction	Hormones are transported by the blood and transmit information from the brain to various organs, such as the skin, breasts, testicles and ovaries, thereby regulating the reproductive system. In studying the ovarian and menstrual cycles, sperm production, fertilization and the stages of pregnancy, students can be introduced to issues relating to male and female sexual maturity, a healthy reproductive system and family planning. In most	– Reproductive organs
		– Hormone regulation
		  • Testosterone, estrogen, progesterone
		  • Ovarian cycle
		  • Menstrual cycle
			Human populations
			– Decrease in the birth rate
			– Overpopulation
			
			Applications
			– Means of contraception
			– The fight against AIDS

The Living World			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**
Reproduction	Western societies, birth control is a question of quality of life, and sometimes even of survival, and different methods are available to those who are interested.	– Fertilization – Pregnancy – Stages of human development – Contraception • Infections transmitted sexually and through the blood	*Community resources* – The school's complementary services – Public health (CLSC)

The senses	The human body reacts to stimuli from the environment received through its sensory receptors. Our senses include taste, sight, touch, smell and hearing. Poor lighting or ventilation, prolonged exposure to excessively high-pitched or loud sounds, and many other factors can alter our sensory systems. Knowledge of the structures of these organs and how they work gives a sense of the need to take care of them (e.g. by adopting healthy lifestyle habits).	– Sensory receptors (eyes, nose, tongue, skin, ears)	*Physical and mental health*
			– Commission de la santé et de la sécurité du travail (CSST)
			  • Safety glasses and boots
			  • Ear protection
			– Everyday life
			  • Volume (sound system, radio, television)
			  • Lighting
			  • Appropriate clothing

Relationships	The circulation of matter (water, soil, air) and energy (light, heat) in nature is based on balanced relationships between plant and animal species and the physical environment of an ecosystem. Students study the influence of various factors, such as sunshine, temperature, precipitation, wind and type of soil on the growth of a plant species, thereby learning accountability for the protection of fauna and flora. On a global scale, human activity has an impact on the balance of ecosystems. It is important to consider concrete individual actions in a context of environmental education.	– Relationships between living organisms in plant and animal communities – Influence of nonliving factors on living organisms – Land and marine ecosystems	*Community resources* – Québec flora and fauna – Biodôme de Montréal – Zoos – Botanical gardens – Aquariums – Natural history museums *Environment* – International treaties on environmental protection – Landscaping – Parks and protected zones – Gardening

Work-Oriented Training Path, Prework Training

The Earth and Space

Knowledge about the Earth and space enables students to learn about the variety and fragility of our planet's resources. It provides an opportunity to reflect on the major issues of the day, such as pollution and energy choices.

The Earth and Space			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**
Geological and geophysical phenomena	The Earth is a complex and fascinating system made up of soil (the lithosphere), water (the hydrosphere) and air (the atmosphere). All of these components provide numerous natural resources we can use, for example, minerals in the subsoil, forests, arable land, waterways and wind. A study of the water cycle and a few meteorological principles show how much these complex systems are influenced by human activity.	*Resources of the lithosphere* – Types of soils – Basic minerals – Precious and semi precious stones *Hydrosphere* – The water cycle *Atmosphere* – Composition – Meteorology	*Applications* – James Bay – Natural resources in Québec (mines, forests) – Wind energy *Events* – The ice storm of 1998 – The Saguenay flood of 1996 *Geography* – St. Lawrence River – Geological regions
Astronomical phenomena	With the seasons, constellations, planets and other objects visible to the naked eye cross the night sky. Star identification devices can be helpful, but it is useful to be familiar with a few landmarks such as the Big Dipper, the Little Dipper and the North Star, which points north. A study of the Earth's movement helps explain a number of phenomena, such as the alternation of day and night, the phases of the moon, eclipses, the tides and the seasons.	*Visible to the naked eye* – Stars – North Star – Constellations – Star identification devices – Phases of the moon – Eclipses – Seasons – Northern lights *Solar system* – Planets – Movement of the Earth (revolution, rotation)	*Community resources* – Astronomical observatories – Scientific pastimes – Web sites *Events* – Manicouagan crater – Charlevoix astrobleme *Applications* – Canadian Space Agency – International Space Station *History* – Conquest of space

The Technological World

By becoming familiar with the technological world, students learn that technology is an integral part of the world around them. They learn what they need to design and build a prototype of a technical object.

The Technological World			
General Concepts	**Orientations**	**Specific Concepts**	**Cultural References**
Engineering	Specifications[2] and schematic diagrams are used to record or represent the relevant elements of a technological design or analysis process. The discovery of new types of materials or new properties made it possible to improve the performance of technical objects in different spheres of activity. In electricity, the concepts are related to the different components of an electrical circuit and their functions. For example, fuses prevent circuit overloads.	– Specifications – Schematic diagram – Raw material – Material *Electricity* – Supply – Conduction, insulation and protection – Control	*History* – The evolution of machines and tools and its impact on trades – Inventions – Joseph-Armand Bombardier *Economy* – Canadian Intellectual Property Office (CIPO) *Applications* – Power tools – Small household appliances
Forces and motion	An analysis of technical objects provides concrete evidence of the presence of forces and motion. The forces that act on the parts of a mechanism modify their motion and exert mechanical constraints that may cause heating, deformation or ruptures. The application of the concept of forces and motion helps students understand certain simple machines and how transmissions (gears, pulleys, ball bearings, worm gears) work.	– Simple machines (e.g. lever, screw, wedge) – Mechanisms for the transmission of motion	*Sports and leisure activities* – Transportation technology (bicycle, sailboard, skateboard) *History* – Industrial Revolution

2. Text containing the desired function as well as all the requirements and constraints associated with the design and use of a technical object.

Work-Oriented Training Path, Prework Training

Strategies, Techniques and Attitudes

Strategies

A number of strategies in the Technological and Scientific Experimentation program help students develop the three subject-specific competencies.

These strategies are divided into three categories: exploration and problem-solving strategies, instrumentation strategies and communication strategies.

Exploration and problem-solving strategies	– Breaking down a complex problem into simpler subproblems – Establishing the constraints involved in solving a problem or producing an object – Using various methods of reasoning – Illustrating the problem in a drawing or diagram – Formulating questions or hypotheses – Becoming aware of their initial representations – Thinking of similar problems they have solved – Exploring various possible solutions – Anticipating the results of the process – Making adjustments to the process when necessary – Thinking about their mistakes
Instrumentation strategies	– Using a variety of information sources, techniques and observation tools – Using drawing techniques to illustrate a solution – Using an ideas manager[3] – Using recording tools
Communication strategies	– Organizing data for presentation – Exchanging information – Comparing different possible explanations or solutions – Using a variety of means of communication, for example, doing a presentation using an ideas manager and a multimedia projector – Using tools to draw a diagram or represent data

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3. http://www.recitadaptscol.qc.ca/spip.php?article21

Techniques

Techniques involve methodical procedures that provide guidelines for the effective application of theoretical knowledge. The following table presents the work methods used in the learning and evaluation situations.

Science	Technology	
	Graphical language	Manufacturing
– Collecting samples – Separating mixtures – Using lab equipment safely – Using measuring instruments (scale, graduated cylinder, thermometer) – Using observation instruments	– Reading drawings – Drawing diagrams (drawings, sketches) – Using drafting instruments (rulers, squares) – Using terminology and symbols	– Using tools and simple machines – Measuring and marking out – Machining and shaping – Finishing – Assembling and disassembling

Attitudes

The attitudes in the Technological and Scientific Experimentation program are divided into two categories: intellectual attitudes and behavioural attitudes. Intellectual attitudes involve openness to the diversity of knowledge, points of view and approaches possible in dealing with scientific and technological problems. Behavioural attitudes involve students' manner of conducting themselves and contribute to personal development, life skills and work skills. The two types of attitudes are complementary.

Intellectual Attitudes	Behavioural Attitudes
– Curiosity – Initiative – Interest in comparing ideas – Creativity – Concern for objectivity – Use of the appropriate language	– Discipline – Autonomy – Perseverance – Sense of responsibility – Sense of effort – Cooperation – Observance of health and safety rules – Respect for life and the environment – Attentiveness – Team spirit – Interest in the social and environmental issues of the day

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