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Aligned Instructional Systems:

Canada

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Contents

Canada

Canada is a federal country with a population of around 30 million people. It comprises ten provinces and three territories. Canada is officially a bilingual (English/French) and multicultural country with around 1 million aboriginal people as a well as other large immigrant communities. About 25% of the population is native French speakers, and while they constitute a majority only in Quebec, they represent a sizable minority in all provinces. Historically, the issues of religious and language education have been deeply contested aspects of the Canadian education system.

Under the Canadian constitution, education is the exclusive responsibility of the provinces and territories. Each province or territory has its own ministry or department of education, and, unusually, there is no Canadian minister of education. There is no vehicle for a federal input to education and there is no national education policy or approach. Because of the loose connections between Canadian provinces and the close proximity of the United States, Canadian educators tend to look to the United States both for ideas and as a comparison (Levin 2001). On rare occasions[1], the federal government encourages provinces to take policy action on special issues, although action on the part of provinces on such matters is voluntary.

Provinces collaborate through the Council of Ministers of Education, Canada (CMEC), but this operates through a consensus basis, so is largely a forum for discussion rather than policy making. However, from time to time, CMEC undertakes national projects in curriculum and assessment, such as the *School Achievement Indicators Program* (1993-2004), now the *Pan-Canadian Assessment Program*. This national assessment program – in mathematics, reading and writing, and science for 13- and 16-year-old students – aims to provide data to assist each province and territory in making policy decisions and planning curriculum improvement (O'Donnell 2002; CMEC no date). While CMEC acknowledges that making country-wide comparisons is difficult, it claims that the tests help determine if students across Canada are achieving comparable outcomes. Contextual information is gathered through student, teacher and principal questionnaires.

The Canadian system is internationally distinctive for its efforts to balance respect for diversity of language and religious affiliation with province and territory-wide educational goals. Since the Constitution Act 1867, Canada has sought to protect parents' rights to send their children to Protestant and Catholic schools, subject to provincial control over funding and teachers, but using public funding. This structure means that these schools and school boards in Canada are within the public system and under partial control of the provincial departments of education, not in the private sector (OECD 2012).

[1] An example of this is financial literacy – see Pinto, L.E. 2013. When politics trump evidence: Financial literacy education narratives following the global financial crisis. *Journal of Education Policy*, *28:*1, 95-120.

Despite this independence, there are few fundamental differences between the education systems in the individual provinces. In all provinces schools are run locally by elected school boards, although most of the funding comes from the provincial government. French and English speaking groups, when they are in the minority, have guaranteed rights to education on their own lands (Levin & Read 2013). Funding provided by provinces for education is broadly similar, curriculum is set by the provinces, teachers are required to meet certain standards in all provinces (usually five years of post-secondary education) and all provinces run an accountability or testing regime. All provinces also provide public funds for some religious or other private schools.

One exception to this local responsibility for education is that the federal government is responsible for First Nation education. There are 2,300 reserves on which almost half of Canada's 637,660 First Nations people live. Children educated in these federal schools are outside of the provincial system and so do not feature in PISA samples. It can be argued that in this way Ontario and Alberta, the foci of this report, have cut off their weakest performers from the sample but some might say that since schools on reserves are not part of the public school system then not counting them in is appropriate. In Feb 2014, the Harper government produced a First Nations education package (Bill C-33), which is intended to ensure reserve schools attain the same standards as provincial schools (Parliament of Canada 2014).

Adult literacy and essential skills are also in the remit of the federal government through the Office of Literacy and Essential Skills (OLES). However, in March 2014 OLES rejected most of the bids for funding and, according to the sector, effectively ended federal funding for organizations in the adult literacy sector (Pearson 2014). While the federal government has suggested it would prefer to fund directly service delivery, it does not have the jurisdictional mandate to do so in education. The OLES website currently states that it "does not provide funding for training services or for the operating needs of training providers. Its efforts complement those of provincial and territorial governments, which are the primary funders of LES training services" (Employment and Social Development Canada 2014).

Teachers are unionized in Canada, and the unit of collective bargaining varies across provinces with some negotiations taking place at the local level, some at the provincial level, and some which are mixed. Teacher training takes place in universities, although the standards for certification have traditionally been set by the provinces. For example, in 1996, Ontario created the Ontario College of Teachers which has exclusive responsibility for governing entry, discipline, and professional development of teachers; on its 31 member governing council sit 17 teachers elected by the college and 14 members appointed by the Ontario Minster of Education. More traditional issues, such as wages, continue to fall under collective bargaining and are separate from the College of Teachers (OECD 2010).

The Canadian culture makes it well placed for student success. According to PISA questionnaires, parents are very supportive of their children's schooling, Canadians accept that their society has a collective responsibility for children's welfare and Canadian students are

more likely than children in the rest of the world to read for pleasure on a daily basis (OECD 2010).

While both Ontario and Alberta score well in PISA testing, Ontario appears to have the greater confidence; it has promoted its model of educational reform, focusing on literacy and numeracy and high school graduation, setting system targets and driving change from the center with the support of school staff, as a transferable model for others to copy. However, it is not clear from comparative data alone that its model is more effective based on empirical evidence than other Canadian provinces (Hargreaves 2013).

Province of Alberta

History and background

Alberta is a Western province of approximately three million people, concentrated in two large cities, Edmonton and Calgary. The population is mixed and includes large numbers of immigrants and aboriginal minorities. Politically Alberta is one of Canada's most conservative provinces and has been led by the Progressive Conservative Association continuously since 1971. Provincial politics tend to be dominated by low tax rates – Alberta is the only province without a sales tax – and tendency towards self-reliance, although oil revenues have meant that until the end of the 1980s public spending was similar to the other Canadian provinces.

Alberta has around 1800 public and private schools for its 525,000 students although only about 4% attend private schools, which attract some state support. Public schools are organized into school districts with locally elected boards.

As with other Canadian provinces, the Alberta Department of Education provides funding for schools, sets detailed school curricula and sets regulations. Teachers are unionised through the Alberta Teachers' Association, but collective bargaining occurs at the school district level (Levin 2001). However, teachers at charter schools are *not* part of the Alberta Teachers' Association, or any other union.

The reform process in Alberta started in 1994 with a program of severe province-wide spending reductions, with education required to reduce its funding overall by 12%. This program led to the elimination of provincial funding for kindergarten, a reduction in the number of school districts from 140 to 60, the authorisation of a limited number of charter schools, an increase in provincial testing and a requirement for all school districts to publicize an annual business plan (Levin 2001).

Alberta Initiative for School Improvement (AISI) planning began in 1999 and was implemented in all Alberta school districts in 2001-2002. AISI was a twelve-year old formal initiative of government supported site-based, action research projects. AISI provided funding for K-12 Alberta school jurisdictions for projects that addressed local needs and circumstances to

improve student learning. AISI was regarded by some as one of the best examples of a sustained, site-based school improvement initiative anywhere in the world (Hargreaves et al 2009). The principal characteristics of AISI included:

- AISI was designed by all Alberta's major educational partners – including the Universities, the Alberta Teachers Association (ATA), College of Alberta School Superintendents (CASS), Alberta School Boards Association (ASBA), Association of School Business Officials of Alberta (ASBOA) and the Alberta School Councils Association (ASCA)
- each action research project was longitudinal (three years in length) and created and managed on-site by local teachers at the district level
- each school district received approximately $75 per student annually to create, run, and manage the action research projects
- AISI projects received ongoing support from Alberta's educational partners – including university-based educators from Alberta's three largest teacher educational institutions – the University of Alberta, the University of Calgary, and the University of Lethbridge (Parsons and Beauchamp, 2012).

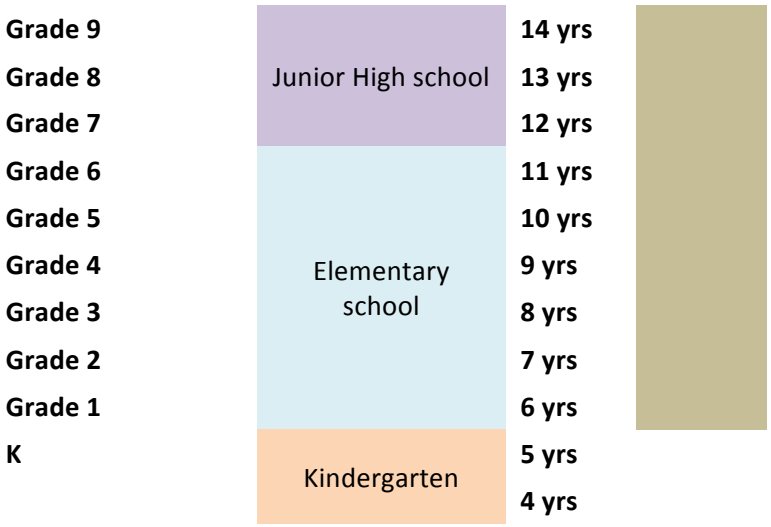
However, as part of a round of district budget freezes, the AISI ended in March 2013, and all funds were suspended as of April 1, 2013 (Alberta Education 2014).

Structure of educational system

In Alberta, the ministry, known as Alberta Education, is responsible for children's education Early Childhood Services (ECS) to Grade 12. Alberta Education provides the managerial and financial framework for school boards, independent and private schools, and sets instructional policies, programs and evaluation strategies. The delivery of educational services is delegated to jurisdictions that are managed by an elected board of trustees, who then hire a superintendent to act as the chief education officer for the district (McEwen, 1995, Alberta Education 2014i).

There are three types of schools in Alberta. Public (state) schools that are governed by local school boards; public schools with a designated alternative program that specialize in curricular themes and instruction methods or programs (such as Montessori, arts-based education, language immersion or talented children); and private schools that are affiliated with religious groups or have an academic or philosophical focus.

Types of schooling, ages of transition



By law, children living in Alberta must attend school from ages six to 16. The Education Act passed in 2012 raises the school leaving age to 17 in the academic year 2015-2016. Kindergarten (for five to six year olds) is optional, but generally available. Public education is provided free for children less than 20 years old, up to the end of secondary school. The major school types are public, separate (separate sex), francophone and charter.

Schools are categorized as elementary (kindergarten through 6th grade), junior high (7th through 9th grade) and senior high (10th through 12th grade). The minimum number of hours of instruction for Grades 1 to 9 is 950; for Grades 10 to 12 it is 1000. The school year is between 190 and 200 days, depending on the school district.

Policy aims and vision

The overall vision for Alberta's education system is that all students are inspired to achieve success and fulfillment as engaged thinkers and ethical citizens with an entrepreneurial spirit.

The goals for Alberta education Kindergarten through to Grade 12 are for students to:

- be engaged thinkers and ethical citizens with an entrepreneurial spirit
- strive for engagement and personal excellence in their learning journey
- employ literacy and numeracy to construct and communicate meaning
- discover, develop and apply competencies across subject and discipline areas for learning, work and life to enable students to:
    - know how to learn: to gain knowledge, understanding or skills through experience, study, and interaction with others
    - think critically: conceptualize, apply, analyze, synthesize, and evaluate to construct knowledge
    - identify and solve complex problems

- manage information: access, interpret, evaluate and use information effectively, efficiently, and ethically
- innovate: create, generate and apply new ideas or concepts
- create opportunities through play, imagination, reflection, negotiation, and competition, with an entrepreneurial spirit
- apply multiple literacies: reading, writing, mathematics, technology, languages, media, and personal finance
- demonstrate good communication skills and the ability to work cooperatively with others
- demonstrate global and cultural understanding, considering the economy and sustainable development
- identify and apply career and life skills through personal growth and well-being.

These goals are contextualized in Alberta's education mission statement, which stresses economic need:

> Collaborate to inspire every student to engage in high quality, inclusive learning opportunities needed to develop competencies required to contribute to an enriched society and a sustainable economy (Alberta Government 2014).

21st Century Skills

Alberta Education describes 21st century competencies as "the attitudes, skills, and knowledge that contribute to students becoming engaged thinkers and ethical citizens with an entrepreneurial spirit." Its website shows a graphic illustrating the relationships among literacy, numeracy, competencies and subject/discipline areas outlined in the *Framework for Student Learning* (Alberta Education 2014c).

In the outer circle of the graphic are the three major competencies of engaged thinkers, ethical citizens and entrepreneurial spirit (see above). Inside this circle are the subject/disciplines. In the next circle are the skills that relate to the three major competencies: critical thinking, problem solving, creativity, innovation, social responsibility, cultural, global and environmental awareness, communication, lifelong learning, self-direction and personal management, digital learning, and collaboration and leadership. Literacy and numeracy are in the inner circle and the 21st century learner is at the heart of the graphic. The subject areas are supposed to provide the context in which the competencies are developed and the opportunities for interdisciplinary learning, with the subject's learning outcomes providing the occasion for deep understanding and appreciation of the competencies. The subject by subject analysis below shows that at least on paper, the key competencies are interwoven throughout the curriculum.

Governance

The *School Act* sets out the legal parameters that govern the education of students in Alberta. The role of government in Alberta education is transparent and it is possible to gain an in-depth understanding of the system through a single government publication, the *Guide to Education 2013-14* (Alberta Education, 2013).

The primary responsibility for educating Alberta's students rests with 62 elected school boards. They are in charge of planning for the jurisdiction, setting priorities for the system in light of community wishes, available resources and sound educational practice. Their responsibilities include:

- setting goals for the jurisdiction, ensuring education stays in step with today's world
- evaluating the School Board Superintendent
- adopting an annual budget for the school system
- making policy to guide the administration and employees toward district goals
- communicating with the community and staff on behalf of the jurisdiction
- educating others, with a goal of ensuring education is given a high priority by the public and to make the community aware of the jurisdiction's achievements
- gathering information in order to make sound decisions
- adjudicating in policy disputes (Alberta Education 2014i).

They must also make decisions regarding the health and safety of their students, including assessing risks and ensuring that the best interests of all their students, teachers, administrators, parents and volunteers are being considered.

In the 2012-2013 academic year, Alberta had:

- 1453 public schools that educated 428,980 students
- 378 separate sex schools that educated 144,071 students
- 34 francophone schools that educated 6,300 students
- 21 charter schools that educated 8448 students
- 149 private schools that educated 26,005 students.

Public/private

In addition to public schools there are charter schools, which are autonomous public schools that are intended to provide innovative, research-based methods to deliver student learning. In order to be deemed a charter school, a school needs to prove that it contains programs that set it apart from other public schools or is designed to meet the learning needs of a specific group of students. The education minister grants the charters after the group interested in setting up a charter school convinces its local school board that it is a viable alternative to existing schools (Alberta Education 2014b).

Alberta also has private schools that provide educational alternatives for parents who wish to have their children taught in accordance with a particular focus. Private schools can be based on religious beliefs, athletics, academics or a particular philosophy of learning. Private schools may charge tuition and other fees as required. In addition, private schools may select their students and are not required to enroll all students.

Textbooks

Textbooks used by Alberta's public schools are developed commercially, and are approved by the province. A recommended list of approved titles is provided from which districts or schools can choose. In addition, Alberta provides a database of all authorized learning and teaching resources, some of which are available digitally.

Accountability

School accountability

Alberta schools operate under an "Accountability Pillar" that attempts to ensure equitable education across the province. It is complemented by two other pillars, "Flexibility" and "Funding", which give local authorities more control over decision-making. Funding arrangements give school authorities equitable funding and flexibility to allocate monies according to learners' needs. School authorities are accountable for the use of resources and results achieved.

The accountability pillar rests on the use of data sets, including student achievement K-12, but is not reliant solely upon those data. Other aspects include: preparation for life-long learning, employment and citizenship; involvement; continuous improvement; safe and caring schools; and student learning opportunities. These are measured through student, parent and teacher input. Results are reported out by each school authority to its local community.

Accountability is based on a common set of student achievement measures province-wide and compares past and present performance based both on achievement and improvement. The achievement standard is measured based on comparative results across Alberta using a baseline of three years' data; the improvement data rest on each school's own data over three years. These are combined in order to report out at the following levels: excellent, good, acceptable, issue and concern. After the results are published, school authorities are obligated to work with local schools to seek necessary improvements (Alberta Education 2010).

Curriculum and assessment standards are shared province-wide. There is, however, an underlying principle of local choice. Local authorities have the flexibility to deploy resources and use any delivery methods as long as they meet the Alberta Education requirements, including outcomes of the programs of study (Alberta Education 2014i).

Teacher accountability

Unlike many other countries, Canada has less strict evaluation requirements for teachers once they have been certificated. Teachers receive certificates for life upon graduation from teacher training programs and are not required to participate in continuous professional development (CPD) in order to keep their certification current – although clearly many do. Only a disciplinary action against a teacher will cause him or her to lose his or her license and not a single Alberta teacher has been dismissed for incompetence over the last decade. In May 2014, a task force recommended to the current government in Alberta that teachers get re-certified every five years. At the time of this writing it is unclear if that recommendation will be put into effect (Alphonso and Maki 2014).

Setting Standards

The Alberta MOE specifies compulsory acceptable levels of educational delivery through a series of Ministerial Orders on Student Learning, Early Childhood Education (Alberta Education 2006), Special Education and the provision of Basic Education (Alberta Education 2014f). Alberta's curriculum is enshrined through programs of study as prescribed by the minister for each of *Elementary Schools, Junior High Schools and Senior High Schools* (Alberta Education 2014d).

Mandatory requirements for programs and courses are outlined in the programs or courses of study, each of which contains the following components:

- program rationale and philosophy
- outcomes
    - general outcomes
    - specific outcomes.

Their content focuses on what students are expected to know and be able to do in each course. The programs of study are available in both English and French for elementary and junior and senior high schools (see below).

In 2008, the government of Alberta started the process of planning a long-term vision for education in Alberta. After carrying out a variety of engagement processes it embarked on a transformation of the education system to help students engage actively in a global, knowledge-based society so as to better prepare them for the rapid changes occurring at the local, national and international levels. The result was the 2011 Alberta Education *Curriculum Redesign,* which aims to ensure that Alberta's curriculum (programs of study, assessment, and learning and teaching resources) remains responsive and relevant for students. *Curriculum Redesign is* anchored in research (theory, quantitative and qualitative studies and innovative practices) that exists within Alberta, Canada and around the world. The objective of the research, including literature reviews and environmental scans, was to collect, collate and analyze the information

obtained and, where possible, to consider the knowledge gained to inform the development of revised standards and guidelines for future curriculum and curriculum development processes (Parsons & Beauchamp 2012).

The goals of the *Curriculum Redesign* are:

- to develop revised standards and guidelines for future curriculum (programs of study, assessment, and learning and teaching resources)
- to develop a cohesive and collaborative process for curriculum development that will ensure that curriculum is responsive to students in a rapidly changing world.

The program is designed to transform the system from one that catered to an industrial era to one that meets the needs of a dynamic and global economy and society, complete with global interaction, competition, engagement and networks. Students are to be equipped with the knowledge, skills and attitudes that will prepare them for jobs that do not yet exist.

Alberta Education is collaborating with publicly funded school authorities and other education partners through the various stages of development of future provincial curriculum. One of these processes is Curriculum Development Prototyping, which provides the opportunity for education partners to contribute in the process of curriculum development at an early stage. The prototyping partners represent more than 30 school authorities across the province, and the lead school authorities are involving a broad range of community members in their networks and partnerships. Community members will provide feedback to prototyping partners on the first draft aspects of curriculum developed by classroom teachers and other educators. Ultimately, the drafts will be submitted to Alberta Education for consideration by our curriculum development staff (Alberta Government 2014).

The aim is for Alberta's future curriculum for Kindergarten to Grade 12 students to be built on a foundation of literacy and numeracy and to be digitally-based. It places greater emphasis on the development of cross-curricular competencies to ensure that students develop an interrelated set of attitudes, skills and knowledge that can be drawn upon and applied for successful learning, work and living. Subjects will increasingly become a means to an end – the vehicles through which literacy, numeracy and competencies are developed by students. A less prescriptive curriculum is being developed that is supposed to enable teachers to meet better students' diverse learning styles and local community needs.

The new curriculum will be:

Less....	**More...**
System-focused	Student-focused
Content focused	Focused on competencies
Prescriptive	Flexible

On summative assessment	Balanced between formative and summative assessment
Print based	Digitally based
Centrally led	Collaborative
Sequential development	Synchronous development

Implementation dates for new programs of study will be determined in collaboration with stakeholders and will include determining stakeholder readiness and supports for implementation of new programs of study.

Teacher training

Initial Teacher Training

To teach in the Alberta Education system, all teachers must hold valid teaching certification prior to commencement of employment with a school authority. The Minister of Education appoints a Registrar who, as Director of the Professional Standards Branch in Alberta Education, is responsible for the evaluation of credentials and issuance of certification for teachers in Alberta.

All applicants for Alberta certification must declare that they are able and committed to applying the appropriate knowledge, skills, and attributes toward student learning as described by the *Teaching Quality Standard Ministerial Order*. They must also commit to teaching practice and professional growth in keeping the *Teacher Growth, Supervision and Evaluation Policy* (Alberta Education 2014h).

Alberta has two levels of teacher certification:

- The *Interim Professional Certificate* is the initial certificate issued to all applicants who meet the requirements as outlined in the regulations. It is valid for a period of three years; once expired, certificates may be re-issued upon the receipt of a recommendation from a school authority
- The *Permanent Professional Certificate* is issued upon receipt of a recommendation from a school authority attesting that:
    - the teacher has completed two years of successful teaching
    - the teacher has had two evaluations based on the knowledge, skills and attributes for permanent certification outlined in the *Teaching Quality Standard* (Alberta Education 2014h).

To gain certification, teachers must meet the requirements of the *Certification of Teachers Regulation*. They are required to provide evidence of:

- a minimum of 16 years of schooling including four years of university education and a degree that includes a structured, pre-service teacher preparation program from a suitable institution. That program has to include at least 48 semester hour credits in education and 10 weeks' teacher training in schools
- elementary teachers must have at least three semester hour credits in each of Canadian Studies, mathematics and science as well as six semester hour credits in English/French literature and composition
- secondary teachers must have at least 24 semester hour credits in a subject area plus six semester hour credits in English/French literature and composition.

Teacher quality standards were legislated in 1997 that govern certification, professional development, supervision and evaluation. They are underpinned by descriptions of the knowledge, skills and attributes that teachers must have at various stages of their careers. All teachers are expected to meet the quality standards. Features included are:

- the contextual variables that affect teaching and learning; knowledge of the education system's structure, including roles, responsibilities and accountabilities
- the use of programs of study to plan instruction and assessment
- the teacher's own specialized subject discipline
- knowledge of learning styles for individuals and groups
- the purposes of short, medium and long term planning and how to translate those plans into progressive learning opportunities
- the need for safe physical, social, cultural and psychological classroom environments
- varied teaching and learning instructional strategies
- the need to respect students' dignity
- teaching and learning technologies
- the purpose and uses of classroom-based and provincial student assessment
- the importance of parental and community engagement and resources
- the importance of on-going professional development and commitment to their school (Alberta Education 2014h).

Continuous Professional Development

According to the 2013 OECD TALIS survey (OECD 2014c) while teachers in Alberta enjoy their work and feel teaching is a good profession less than half (47%) think that teachers are valued in the wider society. This proportion rises substantially for those who believe they are given an opportunity to participate in school decision-making, suggesting that participation in school management is an important way to help teachers feel valued.

Teachers in Alberta are confident of their classroom management skills, but less confident in their ability to motivate uninterested students. Although almost all teachers in the province have completed a teacher education program, 44% reported that they had not received training on the content of all the subjects they taught and 49% had received no training on subject specific pedagogy. This suggests that despite the high take up of professional development courses

(98% compared to a TALIS average of 88%) there remains a need for greater provision (and uptake) of subject specific content and pedagogy in such programs.

Most teachers report receiving feedback on their teaching, either formally or informally; however, only 51-60% reported that this had a positive impact (compared to a TALIS average of 63-70%). Alberta teachers spend more of their time teaching than many other groups in the TALIS survey, but in all other respects they are close to the average for the survey.

Teachers were positive about their relationships with students despite the fact that Alberta has some of the highest weekly absentee rates among the surveyed countries (62%) with a similarly high record for late arrivals at school (70%).

Curriculum overview

The following are the recommended time allocations for each subject area for Grades 1 - 9.

<table>
<tr><th></th><th colspan="2">Grades 1 – 2 (Percentages)</th><th colspan="2">Grades 3 – 6 (Percentages)</th><th colspan="2">Junior High School (Hours)</th></tr>
<tr><td></td><td>English language</td><td>French language</td><td>English language</td><td>French language</td><td>English language</td><td>French language</td></tr>
<tr><td>English language Arts</td><td>30%</td><td rowspan="2">Combined 30%</td><td>25%</td><td rowspan="2">Combined 35%</td><td>150</td><td rowspan="2">Combined 250</td></tr>
<tr><td>French language Arts</td><td>0%</td><td></td><td>0</td></tr>
<tr><td>Mathematics</td><td>15%</td><td>15%</td><td>15%</td><td>15%</td><td>100</td><td>100</td></tr>
<tr><td>Science</td><td>10%</td><td>10%</td><td>15%</td><td>10%</td><td>100</td><td>100</td></tr>
<tr><td>Social Studies</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td>100</td><td>100</td></tr>
<tr><td>Art and music</td><td>10%</td><td>10%</td><td>10%</td><td>10%</td><td></td><td></td></tr>
<tr><td>Physical education</td><td rowspan="2">Combined 10%</td><td rowspan="2">Combined 10%</td><td>10%</td><td>10%</td><td>75</td><td>75</td></tr>
<tr><td>Health and life skills</td><td>10%</td><td>10%</td><td>50</td><td>50</td></tr>
<tr><td>Other subjects</td><td>15%</td><td>15%</td><td>15%</td><td>10%</td><td>variable</td><td>variable</td></tr>
</table>

Senior high school programs must enable students to:

- meet Alberta High School Diploma requirements (see Alberta Education 2013, p 85) and earn a minimum of 100 credits in three years
- have opportunities to take optional courses
- enter post secondary institutions or seek employment.

There are a range of courses and programs of study for students to follow including:

- career and life management (CALMS)
- English language arts program
- Français program
- French language arts program
- French as a second language
- mathematics program
- science program
- social studies program
- career and technology studies (CTS) – these are organized as five clusters
    - business, administration, finance and information technology (BIT)
    - health, recreation and human services (HRH)
    - media, design and communication arts (MDC)
    - natural resources (NAT)
    - trades, manufacturing and transportation (TMT)
- knowledge and employment (K&E) – for those with reading, writing, mathematical and/or other levels of achievement two to three grade levels below their age appropriate grade.

Senior high school time allocations are below:

Senior High School Graduation Requirements: Diploma (English) 100 credits including the following:

English Language Arts – 30 level [ELA 30-1 or 30-2]
Social Studies – 30 level [Social Studies 30-1 or 30-2]
Mathematics – 20 level [Mathematics 20-1, 20-2 or 20-3]
Science – 20 level [Science 20, 24, Biology 20, Chemistry 20 or Physics 20]
Physical Education 10 (3 credits)
Career and Life Management (3 credits)
10 credits in any combination from: • career and technology studies • fine arts • second languages • physical education 20 and/or 30 • knowledge and employability courses • registered apprenticeship program courses • locally developed/acquired and authorized course in CTS, fine arts, second languages or knowledge and employability occupational courses.
10 credits in any 30-level course (in addition to a 30-level English Language Arts and a 30-level

Social Studies course as specified above) These courses may include: • 30-level locally developed/acquired and authorized courses • advanced level (3000 series) in career and technology studies courses • 30-level work experience courses • 30-level registered apprenticeship program courses • 30-level green certificate specialization courses • special projects 30

Senior High School Graduation Requirements: Certificate of Achievement (English)
80 credits including the following:

English Language Arts – 20 or 30 level [ELA 20-2 or 30-4]
Social Studies – 10 or 20 level [Social Studies 10-2 or 20-4]
Mathematics – 10 or 20 level [Mathematics 10-3 or 20-4]
Science – 10 or 20 level [Science 14 or 20-4]
Physical Education 10 (3 credits)
Career and Life Management (3 credits)
5 credits in: • 30-level career and technology studies • 30-level knowledge and employability courses, or • 30-level locally developed/acquired and authorized course with an occupational focus **AND** 5 credits in: • 30-level knowledge and employability workplace practicum course, or • 30-level work experience course, or • 30-level green certificate course • special projects 30
OR 5 credits in • 30-level registered apprenticeship program course

Students who meet the necessary requirements are awarded an Alberta High School Diploma. Students who satisfy these requirements and study in French and take Français 30-1 or Français 30-2 are awarded an Alberta High School Diploma (Francophone).

Students who are enrolled in Knowledge and Employability courses and who satisfy the requirements are awarded a Certificate of High School Achievement.

A Certificate of School Completion in special education can be awarded to students with significant cognitive delays who meet certain qualification criteria. To receive the certificate, students must be nominated by the principal of their school.

Language of instruction

The main language of instruction in Alberta is English, but as befits a nation with a large Francophone population, French language arts features heavily throughout the education system and indigenous languages feature as well. English and French are both official languages of Alberta. Canadian citizens belonging to the Francophone minority in Alberta have the right to enroll their children in a Francophone school administered by a Francophone Regional authority (Government of Canada 2014; Province of Alberta 2014). To support the education of children and students eligible for Francophone education, the Francophone school provides appropriate programing that reflects the pillars of Francophone education: language, identity, culture and community integration.

Assessment Processes

Alberta Education considers the assessment of student progress in relation to the outcomes outlined in programs of study to be important for the following reasons:

- the information on student progress is essential so that teachers can change or refine instructional plans to ensure learning activities are appropriate for all students
- the information is required for reporting student progress clearly to students and parents
- the information is used in making decisions regarding student placement
- the information is required for the evaluation of program effectiveness and for the revision of programs to improve student learning.

The assessment of student progress serves as a guide for learning and instruction and knowledge about each student's current level of achievement is essential for planning learning activities to meet learning needs.

Assessment information is collected in a variety of ways to provide feedback that is useful to student and teacher alike. To be most useful, classroom assessment should have the following characteristics:

- it should be part of instruction and should clearly reveal to students what is expected of them
- it should be an ongoing process rather than a set of isolated events, with the methods and instruments varied and used in a variety of contexts

- it should focus on a broad range of outcomes, reflecting multiple dimensions of skill development
- the measures should be appropriate to the student's development and cultural background
- it should be constructive. It should focus on what a student can do, clearly identifying both strengths and areas of difficulty. It should encourage improvement in areas of difficulty, linking new learning to what a student already knows and can do
- it should involve students in their own assessment. This gives them responsibility for their own learning and fosters lifelong learning (Alberta Education 2013).

Assessment for Learning

The AISI initiative included the theme Assessment for Learning (AfL). This provided a range of support and resources for teachers to develop assessment for learning. Assessment for learning is defined as practices that emphasize more formative dimensions of assessment, tighter connections between learning outcomes and teaching activities, greater student involvement in self-assessment, increasing student independence and enhanced teacher responsibility for ensuring all students learn.

AISI defined AfL as, "practices that emphasize more formative dimensions of assessment, tighter connections between learning outcomes and teaching activities, greater student involvement in self-assessment, increasing student independence and enhanced teacher responsibility for ensuring all students learn." It emphasized clear, shared understanding between teachers and students of learning outcomes and success criteria, student self-assessment and the continuous, timely exchange between teachers and students about student progress.

The AISI initiative seemed to be quite successful in promoting these learning strategies.
In its third cycle (2006- 2009), over 51% of AISI projects identified assessment for learning as a central theme and in the fourth (2009-2012) over 35% of projects did so, with over 60% of projects incorporating AfL instructional strategies in their AISI projects.

The current provincial assessment system, Provincial Assessment Tests (PAT), tests children at the end of Grade 3 in English language and mathematics and Grades 6 and 9 in English, mathematics, science, social studies and French. They are curriculum-based achievement tests that provide information on how well individual students are achieving on the provincial programs of study as well as whole class and whole school information.
The PATs use multiple-choice, numerical- and written-response items. Feedback to parents and students is in the form of a numeric score and the standard (Acceptable Standard, Standard of Excellence, Below Acceptable Standard) achieved.

Teachers are supposed to use the outcomes in instructional planning and delivery. They can be used to compare results throughout the province. School administrators are supposed to take the results into account when reporting out the school's annual progress and also to set goals,

priorities and targets as part of the school's education plan. System-wide the results can be used to monitor student learning and to inform curriculum redesign. Results are reported out publicly and in that sense can be perceived as instruments of accountability. Teacher evaluations are not tied to test outcomes and Alberta Education states that the tests only assess part of the learning programs and should be interpreted in the context of local programs (Alberta Education 2013; Andrews et al 2007).

Alberta Education is in the process of replacing the PATs with new Student Learning Assessments (SLAs). These will provide students, teachers, and parents with information at the beginning of the school year to plan for learning. The ministry believes that collecting and receiving the information at this point in the school year, rather than at the end, will serve as useful reference for everyone and enable collaboration between parents and teachers to support student learning during the year. The ministry sees SLAs as "readiness" assessments to be used to determine the programing needs and support more personalized learning. They are computer-based and interactive and will concentrate on literacy and numeracy. Unlike the curriculum based PATs, the SLAs are meant to assess problem solving, critical thinking and creativity, all of which feature as 21st century skills.

The information from the SLAs will be used to generate a report that details each student's strengths and areas requiring improvement relative to provincial standards. There will also be information on how each student's performance compares provincially to other students. The main purposes of the tests are to improve student learning and enhance instruction. They are meant to complement teachers' continuous assessment in the classroom, and as with the PATs, teachers will be involved in blueprinting, item development, field testing, test validation, French translation validation, standards-setting and results interpreting. Alberta Education states that district superintendents may use the tests' outcomes to allocated resources appropriately.

Grade 3 students will be the first to write the new assessments, with pilots starting in September 2014. Full implementation for Grade 3 is expected by September 2015. Pilots for Grades 6 and 9 are scheduled to begin in 2015 and 2016, respectively (Alberta Education 2014g).

For older students, the Diploma Examinations Program consists of course-specific examinations based on the senior high school programs of study. Students enrolled in the following courses are must take diploma examinations:

- science 30, biology 30, chemistry 30, physics 30
- English language arts 30-1, 30-2
- Français 30-1, French language arts 30-1
- mathematics 30-1, mathematics 30-2
- social studies 30-1, social Studies 30-2.

The final mark for diploma examination courses is determined by blending the diploma examination mark with the school-based mark. To obtain credit in a diploma examination

course, students must take the appropriate diploma examination and obtain a final mark in the course of 50% or higher. All diploma examinations are available in French, except for English Language Arts 30-1, English Language Arts 30-2 and Science 30. Students can elect to take either the French or English language version.

International testing[2]

PISA 2012	Score	Rank: CANADA	Point difference highest (95%)/ lowest (5%) achievers	Below level 2 (basic skills for life and work)	Levels 5 and 6 (top performers)
Mathematical literacy	517	13th of 65	297 points OECD = 302	15% OECD = 23%	17% OECD = 13%
Reading	525	9th of 65	296 OECD = 310	11% OECD = 18%	14% OECD = 8%
Scientific literacy	539	10th of 65	311 OECD = 304	11% OECD = 18%	16% OECD = 8%
Problem solving	531	8th of 44		14%	19%

Alberta's PISA results are not statistically significantly different from Canada's overall in mathematics and reading, and were significantly better than Canada's in science. The points differences between its highest and lowest achievers, which the OECD uses as a measure of educational equity, i.e. the lower the point difference, the closer educational opportunities are for all students, is slightly lower than the OECD average, except for science, which is slightly higher. However, between 2003 and 2012, Alberta's performance in mathematics declined by 32 points[3], reading scores declined by 25 points between 2000 and 2012 and science scores declined by 11 points between 2006 and 2012 (OECD 2014a, OECD 2014b, OECD 2013).

PIRLS and TIMSS 2011

	Score	Rank	Advanced International Benchmark (625)	Low International Benchmark (400)
PIRLS 4th grade	548	12th of 45 (Canada)	13% International Median = 8%	97% International Median = 95%
TIMSS math 4th grade	507	29th of 57	3% International Median = 4%	94% International Median = 90%
TIMSS math 8th grade	505	21st of 56	3% International Median = 3%	95% International Median = 75%
TIMSS science 4th grade	541	9th of 57	11% International Median = 5%	97% International Median = 92%

[2] Although PIRLS, TIMSS and PISA all have a mean score of 500 and a standard deviation of 100, because different countries participate in the assessments, the scores cannot be compared across instruments, i.e. a 570 in TIMSS does not equal a 570 in PISA. The same, obviously, is true for rank order – coming in 4th in PIRLS does not equal coming in 4th in PISA.

[3] As a rule of thumb, the OECD equates 40 points with one academic year's learning.

TIMSS science 8th grade	546	8th of 56	12% International Median = 4%	98% International Median = 79%

Alberta's 2011 PIRLS score was exactly the same as Canada's overall, although it was 12 points lower than in 2006. Students were stronger in literary than in informational reading. Canada did not take part as a country in TIMSS 2011; instead Alberta, Ontario and Quebec participated as benchmarking entities. Alberta's scores in 4th grade mathematics, 8th grade mathematics, 4th grade science and 8th grade science have decreased since 1995 by 22, 14 and 4 points respectively (Martin et al 2012, Mullis et al 2012 PIRLS, Mullis et al 2012 TIMSS).

National Academic Achievement Testing

Since 1993, Alberta has participated in School Achievement Indicators Program (SAIP), conducted across Canada by CMEC. Through SAIP, CMEC administered assessments of achievement in mathematics, reading/writing, and science for students aged 13 and 16 across Canada. The program was replaced in 2007 with the Pan-Canadian Assessment Program (PCAP), which assesses Grade 8 (age 14) students. The purpose of both SAIP and PCAP was to give provinces and territories an insight into their curricula and to compare student achievement across Canada. PCAP complements provincial assessments; the tests were developed by teachers working with CMEC. Results are available at provincial/territorial level only – students, schools and district information is not available.

PCAP includes mathematics, reading, and science in each assessment, one being the major area and the other two being the minor areas to be assessed (as also found in PISA). The first PCAP assessment was administered in 2007 with a focus on reading. The second PCAP was administered in spring 2010 with a focus on mathematics.

In 2010 Alberta's Grade 8 students achieved the highest marks in the country in science, with a score of 515, which was above the Canadian average (set at 500) Alberta scored below the Canadian average in mathematics with a score of 495 Alberta scored above the Canadian average in reading, with a score of 506.

Scored from levels 1 (lowest) to 4 (highest), in mathematics, 7% of Alberta's students were functioning at level 1 (lowest of all the provinces) and 3% were at level 4 (Alberta Education 2013).

Detailed analysis of curriculum

In this section, the following key areas of the Alberta curriculum have been analyzed: primary language, mathematics, general science and history, and secondary language, mathematics, earth science, biology, chemistry, physics, history and geography (social studies) and vocational education. The areas of the analysis are:

- orientation – the aims, goals and rationale for the subject/content area
- coherence and clarity – the extent to which the curricula contain clear and specific goals for each grade and whether the suggested learning activities and pedagogical materials support those goals
- scope – the scope of material coverage, the number or amount of items or goals in the curriculum versus the depth of mastery proposed of each one
- levels of difficulty – to what extent the curricula items can be judged to be at the appropriate levels of difficulty. An appropriate level of difficulty should be defined as one that builds sequentially on prior and existing knowledge and presents an achievable challenge to the average student
- integration – how the different subjects within each grade of the curriculum is internally aligned
- progression – how smoothly and coherently the learning goals and proposed content of a given curriculum in a given subject progress from one grade level to the next.

Primary: English education

Orientation:
The vision is to prepare students for present and future language requirements and demands both locally and as part of an international community. Alongside this runs the belief that using language effectively will enhance students' personal satisfaction and ability to contribute as citizens, with opportunities for lifelong learning.

The importance of language is highlighted, referencing it as the basis of "all communication and the primary instrument of thought." There is emphasis on the role of language to explore and communicate meaning. Its role at a personal level as a mark of personal identity and essential element for forming personal relationships, as well as for contributing to society, is clearly stated.

The aim of English language education is to enable each student to understand and appreciate language, and to use it confidently and competently in a variety of situations for communication, personal satisfaction and learning.

Coherence and Clarity:
It is stated clearly that "all the language arts are interrelated and interdependent; facility in one strengthens and supports the others." The six language arts are integrated in the outcomes of the program of study. Listening and speaking, reading and writing, viewing and representing are represented by five general outcomes explicitly linked to the aim of English Language Arts (ELA).

The five outcomes seek to meet the aim through:

1. exploring thoughts, ideas, feelings and experiences

2. comprehending and responding personally and critically to oral, print and other media texts
3. managing ideas and information
4. enhancing the clarity and artistry of communication
5. respecting, supporting and collaborating with others.

Each of these outcomes is prefaced with the six language arts, for example:

> General Outcome 1: Students will listen, speak, read, write, view and represent to explore thoughts, ideas, feelings and experiences.

Each outcome is also supported by an icon that represents the "theme" of that outcome as part of the aim. There is the potential to use this to support students to understand their journey through the program of study in a visual as well as a written form.

The outcomes are supported by sub-headings to highlight the skills of that outcome, for example: Outcome 1 (students will listen, speak, read, write, view and represent to explore thoughts, ideas, feelings and experiences) has two supporting sub headings 1.1. Discover and explore 1.2 Clarify and extend. These subheadings highlight the ways in which the outcome needs to be demonstrated and gives further structure for the program of study.

Building on the subheadings, each learning outcome includes grade specific learning outcomes and students are expected to achieve these by the end of each grade. These specific outcomes state the knowledge, skills and attitudes that students are expected to demonstrate by the end of each grade. They are organized in clusters linked to the subheadings.

For example: Outcome 1.1 Discover and explore is further extrapolated into a cluster of four specific grade outcome headings: express ideas and develop understanding, experiment with language and forms, express preferences, set goals.

For each grade there are bullet pointed grade specific outcomes. Students are expected to meet each succeeding year's grade specific outcomes, and build on and maintain their ability to demonstrate the specific outcomes for previous grades.

The curriculum is organized in sections focused on the general outcomes and so the section on scope will use the general outcomes as sub headings.

Scope:
It is made clear through the structure and wording of the outcomes in the program of study that the standards offer a focus for the four ELA aspects of reading, writing, speaking and listening and language, with a key focus on the fact that the five general outcomes are interrelated and interdependent.

There is a clear focus in the general outcomes on what are considered the underlying skills for effective communication across modes of communication, i.e. reading, writing, speaking and listening. Text is considered to include oral communication and visual media, as well as written text. There is also recognition that these forms are often used in combination with one another and in conjunction with print.

Although it may appear that there are many subheadings for certain general outcomes, there is in general a balance within the number of specific outcomes within these. Some core areas have a greater number of specific outcomes and some grades have more or fewer proportional to progression and cognitive development.

Features of the standards in ELA Kindergarten (K) – Grade 5:
Outcome 1: Explore thoughts, ideas, feelings and experiences
This outcome centers on exploratory language, and it recognizes that this type of language is most often oral. As students move through the grades the aim is that they develop the ability to use exploratory language to achieve other ELA learning outcomes, for example, to enhance comprehension by focusing students' prior knowledge and experience before reading, listening and viewing.

There are four subheadings for Outcome 1.1: and each has no more than three specific outcomes for any one grade. There are three subheadings for Outcome 1.2 and each has no more than one specific outcome for any one grade. Oral, print and other media texts are included in each of the subheadings and represented within each of the specific outcomes, demonstrating the focus on breadth and interconnection between forms of communication.

Within the specific outcomes at each grade there is clear reference to personal response and to prior experience, to making connections between prior knowledge and new information, and through these statements the theoretical underpinning of the curriculum is transferred to the students. Outcome 1 also has the subheading: setting goals. For the learner this prompts a focus on the continued development of this aspect of ELA for lifelong learning.

Outcome 2: Comprehend and respond personally and critically to oral, print and other media texts
The aim is to enable students to build skills of comprehension. The underpinning of how readers / listeners come to an understanding of what they read or hear is embedded in the focus on students being able to monitor their own understanding, through preview, summary, prediction and asking questions.

There are five subheadings for Outcome 2.1 and no grade has more than four specific outcomes.

There are three subheadings for Outcome 2.2 and each has no more than five specific outcomes. For younger age groups the number of specific outcomes is one or two. There are

three subheadings for Outcome 2.3 and each has no more than three specific outcomes, and for most grades there are two specific outcomes. There are three subheadings for Outcome 2.4 and each has no more than two specific outcomes for any grade. Within this outcome there is scope through from response to text into creating original text, but with an emphasis on comprehension and response to text created by other authors. Creating their own text is only covered in 2.4.

Outcome 3: Manage ideas and information
This outcome is intended to build on the focus on viewing and representing, and students learn to enhance the clarity and effectiveness of communication by considering author, purpose, audience and source. In creating their own texts students are encouraged to review how ideas and information are managed.

There are three subheadings for each of Outcome 3.1, 3.2, and 3.3. There are two subheadings for 3.4. There are no more than three specific outcomes for any grade for any subheading, and often only one specific outcome.

Outcome 4: Enhance the clarity and artistry of communication
In the scope of this outcome there is an emphasis on relating to other outcomes. This outcome focuses on application of conventions of grammar, language usage, spelling and punctuation / capitalization. This outcome offers support for students to understand how language works and how to use specialized vocabulary.

There are five subheadings for Outcome 4.1. There are no more than three specific outcomes for each and for most grades only one. There are three subheadings for 4.2. There are no more than four specific outcomes for each, and the specific outcomes are balanced to reflect skills across the grades, for example, only one specific outcome for grammar and usage for Kindergarten but four for Grades 3 – 5. There are four subheadings for 4.3. There are no more than two specific outcomes for this present and share focus for any one grade. For most there is only one specific outcome per grade.

Outcome 5: Respect, support and collaborate with others
Here the emphasis is on language building community, and the students learning to develop their collaboration skills. Students are using language to share perspectives and ideas, as well as to develop understandings and adjust viewpoints.

There are four subheadings for Outcome 5.1. There are no more than two specific outcomes for any one grade. There are three subheadings for Outcome 5.2. There are no more than two specific outcomes for any one grade.

Levels of Demand:
Reading, writing, speaking and listening are completely integrated into the five general outcomes, but for the purpose of this brief commentary, levels of demand have been treated as

separate aspects of ELA. There is a clear emphasis that students will need to build on and use their prior knowledge, and this is reflected within the specific outcomes.

Reading:
The level of demand is clearly considered within the specific outcomes at each grade level. There is demand for students to respond personally to text, and to appreciate the artistry within texts, for example, Grade 5 to "explain how simile and hyperbole are used to create mood and mental images." The fact that this requires explanation and not just identification shows the demand within the program of study.

There is throughout an expectation that the level of demand needs to be met for all genre of text, including digital text, and for a range of forms of text.

Writing:
The level of demand in the statements reflects all aspects of the creation of text as a representation of ideas, views and information. The emphasis on editing and clarification of ideas within Outcome 4.1, enhance and improve, offers an opportunity for all students to develop their experimentation with language and understanding of effective language choices from Kindergarten upwards.

Attending to spelling and grammar conventions is included with emphasis on phonics for lower grades, and a range of strategies for older students. Using skills in phonics to write and handwriting are clear within the specific outcomes. The appropriateness of communication for particular purposes is also highlighted.

Speaking and listening:
The emphasis on oral communication is established throughout the program of study. Every general outcome requires the outcome to be established orally as well as through written representation. Purposes of oral language are clearly defined, for example, questioning, exploratory language, clarification and synthesis of new concepts and ideas into their own words. Speaking and listening across a range of sizes of social context and within new media is also emphasized.

Language:
The demands of the language standards build a sequence to show command of the conventions of English grammar in both speaking and writing. The statements in this aspect are precisely conveyed to show the demand of the development of language conventions between grades, and specific outcomes highlight aspects of conventions, for example, capitalization and punctuation, building on prior knowledge.

Spelling develops in demand from the ability to spell unknown words phonetically to the ability to use spelling patterns and generalizations. This highlights independence in the processes of teaching spelling, as well as rigor in the approach to ensuring that spelling is correct for a reader.

Progression:
It is clear from wording of specific outcomes that progression is considered and supported through each subheading within each general outcome. In general, across the five general outcomes there is a smooth and coherent approach to the articulation of content and standards from grade to grade. Connections can be seen between outcomes and threads of skills and knowledge are developed sequentially.

There are examples within the subheadings for certain general outcomes where the specific outcomes end at a particular grade. For example, 2.1 Use strategies and cues, use comprehension strategies. Here the specific outcomes end at Grade 3, demonstrating that by this grade the specific outcomes of secure sight vocabulary, ability to read silently and to monitor and confirm meaning should be established.

Similarly the progression shows that for younger age grades there is concern for the foundation of knowledge and skills, for example, with a progression from oral skills to written representation in 3.1 Plan and focus from Kindergarten to Grade 5. Also progression in 4.1 from Kindergarten, where the children move from making statements about their own and others' pictures, stories or talk, to using their skills to respond to the work of others as they would to text written by any writer, for example, Grade 4 "identify the general impression and main idea communicated by own and peers' oral, print and other media texts." Students then need to do this collaboratively in Grade 6.

Assessment:
Schools are able to use the new Student Learning Assessments (SLAs) from June 2014 or to use the Provincial Achievement Tests (PTAs). In September 2015 the STAs will become the only assessment system available. Grade 3 (nine year olds) are the only grade in the primary phase to take STA assessments.

Reading Test:
The reading test for Grade 3 is a series of short text extracts from non-fiction, narrative or poetry. The questions are all multiple choice and are distributed between reporting categories and language functions. These categories are understanding main ideas / details; organization of ideas and relationships between form and content; associating meaning; synthesizing ideas.

The test is accompanied by a table that shows the reporting category for each question, and links this, in an item description section, to the outcome related to that question. Outcomes 1 to 4 are all represented by questions.

The texts are presented in a colorful and accessible manner for the students, and are examples from published texts for children. Level of text is appropriate for the grade and sentence structures and organization of text match the specific outcomes.

The questions do not appear to have significant issues of construct variance. Key words are given in capitals, lines where text can be found are clearly signposted and the text referred to in the question is shown in quotation marks.

Key competencies:
Critical thinking and creative thinking is emphasized and it is made clear that students are required to, through language, reflect, speculate, create, analyze and synthesize. There is also an emphasis that language will facilitate the metacognitive processes and that students will be able to reflect on and control their own thinking and learning processes.

Development of creativity is offered through the program of study as the students incorporate new learning into creating their own texts in a range of media for a range of purposes.

Collaboration as part of a team or small group is clearly expressed through the specific outcomes related to General Outcome 5: respect, support and collaborate with others. There is an expectation that in every classroom there will be a sense of community and that students will have the opportunity to work together to meet common goals. There is the intention that language will be used to offer assistance and to participate and enrich the classroom community, as well as to give students the opportunity to reflect on, appraise and celebrate their achievements and personal growth.

Primary: Mathematics

This information on primary mathematics is drawn from *The Alberta K-9 Mathematics Program of Studies with Achievement Indicators 2007*. This in turn draws on *The Common Curriculum Framework for K-9 Mathematics: Western and Northern Canadian Protocol*, May 2006.

Orientation:
The documents state that the main goals of mathematics education are to prepare students to:

- use mathematics confidently to solve problems
- communicate and reason mathematically
- appreciate and value mathematics
- make connections between mathematics and its applications
- commit themselves to lifelong learning
- become mathematically literate adults, using mathematics to contribute to society.

Coherence and Clarity:
General outcomes are the same across grades and are very general. Specific outcomes are clear. Achievement indicators give a little more detail of what might be included at each grade.

Scope:
The curriculum is organized by grade and the extensive curriculum document consists mainly of tables of content. There are four content strands (most with sub-strands) and seven

mathematical processes. The conceptual framework for K-9 mathematics is tabulated, and as well as strands and mathematical processes contains a category "nature of mathematics" followed by the list: change, constancy, number sense, patterns, relationships, spatial sense, uncertainty. (See Key Competencies below for more on the process strands.) The content strands are:

Number:

- patterns and relations
    - patterns
    - variables and equations

- shape and space
    - measurement

- 3-D objects and 2-D shapes
    - transformations

- statistics and probability
    - data analysis
    - chance and uncertainty

The strands and sub-strands are the same across grades, although occasionally there is no content at a particular grade, for example, there is nothing on transformations at grades K-3. Programs of study are expressed in three ways: general outcomes, specific outcomes, achievement indicators. There is one general outcome for each strand / sub-strand and these are the same across grades. They are very general, for example, the general outcome for number is to develop number sense.

At Kindergarten, there are five specific outcomes for number. These all relate to numbers to 10, including counting, comparing, subitizing and recognizing numerals. There are two specific outcomes at Kindergarten level for the pattern sub-strand of patterns and relations and they deal with sorting objects and making a repeating pattern with objects or otherwise. There are no specific outcomes for the variables and equations sub-strand at this level.

At Kindergarten, the measurement sub-strand of shape and space contains one specific outcome, which is about comparison of length, mass, volume and capacity. The strand concerning 3D objects and 2D shapes has two specific outcomes at this level, which are about sorting, building with and describing 3D objects. There is nothing for the transformations strand at this level. There is no work in the statistics at probability strand at kindergarten level, though it is worth noting that sorting objects, which is often seen as a first step in data handling, appears under pattern.

At Grade 1 there are ten specific outcomes for number. Children extend their counting to 100 and represent objects to 20 in a range of ways. They add and subtract to 20 using objects and

represent addition and subtraction concretely, pictorially and symbolically. They describe and use mental strategies, such as counting on and back or using doubles, for addition and subtraction. The pattern sub-strand of patterns and relations has three specific outcomes at Grade 1. These build on the work with sorting and repeating patterns in the previous year to include use of diagrams and translating repeating patterns from one representation to another. The variables and equations sub-strand of patterns and relations starts at Grade 1 and has two specific outcomes. These both relate to equality and include seeing equality as balance and using the equals symbol.

At Grade 1, the measurement sub-strand of shape and space has one specific outcome, which is about comparing and ordering. The sub-strand dealing with 3D objects and 2D shapes has three specific outcomes. These are about sorting and replicating 3D objects and 2D shapes. There is nothing under transformations at this level. There is nothing listed under the statistics and probability strand at Grade 1, but as in Kindergarten, the work listed under pattern could be seen as an early stage of data handling.

At Grade 2 there are ten specific outcomes for number. Children work with numbers up to 100, recognize odd and even numbers and show understanding of place value and of zero. They add and subtract single digit and two digit numbers using a range of strategies and start to understand properties of addition and subtraction. They further develop mental strategies for addition and subtraction. The pattern sub-strand of patterns and relations includes three specific outcomes at Grade 2. Students do more work on repeating patterns and extend this to increasing patterns. Students sort objects using two attributes. The variables and equations sub-strand has two specific outcomes at Grade two. Students work with equalities and inequalities concretely, pictorially and symbolically and the not equal symbol is introduced.

At Grade 2, there are five specific outcomes for the measurement sub-strand. Most of this is about comparison and ordering using non standard units and understanding conservation. Students also work with problems involving days of the week and months in a year. There are four specific outcomes related to 3D objects and 2D shapes at Grade 2. These are about sorting, comparing, describing and constructing 2D and 3D shapes. There is nothing on transformations at this level. The data analysis strand of statistics and probability has two specific outcomes at Grade 2. These concern gathering and recording data about self and others, including using pictographs. Nothing is listed in the chance and uncertainty sub-strand at Grade 2.

At Grade 3 there are thirteen specific outcomes for number, the most of any grade. Students work with numbers to 1000, including representing them in a range of ways. They use and describe a range of mental strategies for adding and subtracting two digit numbers. Students show an understanding of multiplication, represented in a range of ways up to 5 x 5. They understand division as sharing or grouping and relate division to multiplication. They understand fractions as part of a whole and compare fractions with the same denominator. At Grade 3 there are three specific outcomes for pattern and one for variables and equations. Pattern work at this level includes increasing and decreasing patterns, both numerical and non-

numerical. Under variables and equations, students solve one step addition and subtraction problems using a symbol to represent an unknown.

At Grade 3 there are five specific outcomes for measurement. Students extend their knowledge of time to include hours, minutes and seconds and solve related problems. Students measure length using cm and m and mass using g and kg and convert between units. They estimate and measure the perimeter of regular and irregular shapes. There are two specific outcomes at this level related to 2D shapes and 3D objects. Students describe 3D objects according to the shape of faces and the number of vertices and edges and sort regular and irregular polygons according to the number of sides. There is no work on transformations at this level. There are two specific outcomes for data analysis at Grade 3. These are about collecting and presenting data using, tally marks, line plots, charts and lists and using bar graphs to solve problems. There is nothing under chance and uncertainty at this level.

At Grade 4, there are eleven specific outcomes for number. Students work with numbers up to 10000 and add and subtract three and four digit numbers. They use a range of mental strategies, particularly for multiplication and division and understand the properties of 1 and 0 in relation to multiplication and 1 in relation to division. Multiplication is extended to multiply two or three digit by single digit numbers. Two digit numbers are divided by single digit numbers. Students understand fractions as part of a whole or part of a set and compare and order fractions less than 1. They represent one and two place decimals and relate decimals to fractions. They add and subtract decimals up to two places. At Grade 4 there are four specific outcomes for the pattern sub-strand. Students work with patterns in tables and charts, including using them to represent, describe and extend patterns. There are two specific outcomes under variables and equations. These involve using equations with a symbol representing an unknown to solve problems.

At Grade 4 there are three specific outcomes related to measurement. Students read and record time using digital and analogue clocks and read calendars. They understand area and estimate and measure area using standard units. There is one specific outcome related to 3D shapes and 2D objects at Grade 4, which involves describing and constructing rectangular and triangular prisms. Work on transformations starts at this level with two specific outcomes. These are about understanding congruence and line symmetry. There are two specific outcomes for data analysis at Grade 4. These are about understanding many-to-one correspondence and using this to construct and interpret pictographs and bar graphs. There is nothing for chance and uncertainty at Grade 4.

At Grade 5 there are eleven specific outcomes for number. Students work with numbers up to 1,000,000. They use a range of mental strategies, especially in relation to multiplication facts. They extend multiplication to two digit by two digit numbers and divide three digit by single digit numbers. Students work with equivalent fractions and compare fractions with like and unlike denominators. They compare and order decimals to thousandths, relate decimals to fractions and add and subtract decimals to thousandths. At Grade 5 there is one specific outcome for the pattern sub-strand. This involves determining the rule of a pattern to make predictions. The two

specific outcomes for the variables and equations sub-strand build on previous work with one step equations related to problems and introduce the idea of a letter to represent an unknown.

At Grade 5 there are five specific outcomes related to measurement. Students identify right angles and construct rectangles. They extend measurement of length to include mm. They use standard units for volume and capacity. There are two specific outcomes related to 3D objects and 2D shapes at Grade 5. Students extend their work on properties of 3D objects and 2D shapes to include properties such as parallel, intersecting, perpendicular, vertical and horizontal. They identify and sort a range of named quadrilaterals. There are two specific outcomes related to transformations at Grade 5. Students identify, describe and perform translations, rotations and reflections of 2D shapes. Data analysis at Grade 5 has two specific outcomes. These are about differentiating between first hand and second hand data and about constructing and interpreting double bar graphs. Chance and uncertainty first appears at Grade 5 and there are two specific outcomes at this level. Students describe and compare the likelihood of events occurring using appropriate terminology.

At Grade 6 there are nine specific outcomes for number. Students work with larger numbers and show an understanding of factors, multiples and primes. They relate improper fractions to mixed numbers. Students show an understanding of ratio, of percentages and of integers. Students multiply and divide decimals by single digit whole numbers. They explain and apply the order of operations. At Grade 6 there are two specific outcomes for the pattern sub-strand. Students represent and describe patterns and relations in graphs and tables and use these to solve problems.

At Grade 6 there are three specific outcomes related to measurement. Students extend their knowledge of angles, measure angles in degrees and demonstrate the angle sums of triangles and quadrilaterals. They develop and use formulae for the perimeter of polygons, area of rectangles and volume of right rectangular prisms. There are two specific outcomes for 3D objects and 2D shapes at Grade 6. Students construct and compare different types of triangle and describe and compare the sides and angles of polygons. There are four specific outcomes for transformations at this level. Students perform combinations of transformations on 2D shapes, with and without technology. They plot points in the first quadrant using Cartesian co-ordinates, including as a way of describing transformations. At Grade 6 there are three specific outcomes under data analysis. Students collect and represent data using a range of methods including questionnaires, experiments, databases and electronic media. They analyze data to solve problems and interpret line graphs. There is one specific outcome for chance and uncertainty at Grade 6. Students demonstrate an understanding of probability, including listing possible outcomes, determining theoretical probabilities and carrying out experiments.

Levels of Demand:
This is a broad curriculum with an appropriate level of demand. Because of the way specific outcomes build on those for previous years, there is scope for revision and consolidation as well as the introduction of new ideas. In number, students have met key aspects of number by the end of primary, though there is less emphasis on calculation with fractions than in some

countries. The patterns and relations strand includes some important pre-algebraic ideas that build up to include work on equations by the end of primary. Some of the work on data and probability starts later than in other countries, although standards at the end of primary in these aspects appear at least comparable.

Progression:
Specific outcomes are tabulated under strand headings, so it is easy to read across and see the progression between grades. There is quite a lot of apparent repetition between matching outcomes across grades, although progression is also evident.

Assessment:
Achievement indicators are provided as "samples of how students may demonstrate their achievement." The document also states, "to experience success, students must be taught to set achievable goals and assess themselves as they work towards these goals." The mathematics document gives very little detail on student self assessment or other aspects of formative assessment, although this may well appear elsewhere.

Released achievement tests are available for Grade 3 and Grade 6. The preamble to the tests talks about knowledge, understanding, skills and processes. Released tests include a breakdown of items included. For 2011 Grade 3 this is as follows:

- number 45%
- patterns and relations 20%
- shape and space 25%
- statistics and probability 10%.

For the 2013 Grade 6 test the breakdown is as follows:

- number 38%
- patterns and relations 24%
- shape and space 26%
- statistics and probability 12%.

The 2013 Grade 6 test also offers a breakdown by complexity of items (interesting given that they seem to be multiple choice) as follows:

- low complexity 38%
- moderate complexity 48%
- high complexity 14%.

Key competencies:
The document lists seven mathematical processes:

- communication [C]

- connections [CN]
- mental mathematics and estimation [ME]
- problem solving [PS]
- reasoning [R]
- technology [T]
- visualization [V].

There are statements about the importance of these processes early in the document, although there is little indication of how they might develop across age groups. When the specific outcomes are listed, the initials above are used to indicate which mathematical processes might apply.

Primary: Science

The current curriculum for elementary education is set out in a single document covering Grades 1 to 6. At present the curriculum is under review. In particular, relevant to the framework for this review, the intention is to include in the revised curriculum:

- a greater focus on competencies
- opportunities for local decision making and greater depth of study
- balance among formative and summative assessment.

Orientation:
The *program overview* provides a rationale for the science curriculum. High priority is given to fostering and building on children's natural curiosity about the world around them, reflected throughout the document. The program aims to engage children in inquiry and problem solving, developing their knowledge, skills and confidence and providing a basis for future learning and for their lives as citizens in a rapidly changing world.

The program emphasis is made explicit – that children should "learn to inquire and solve problems in a variety of contexts." This is underlined in the two strands in the learner expectations for skill development for each grade "science inquiry" and "problem solving through technology." In line with the rationale for the curriculum, expectations are also set out for the development of positive attitudes for the study of science and the application of science in responsible ways. Finally the program structure lists five topics to be studied during each grade with associated expectations for the development of scientific understanding.

Coherence and Clarity:
For each grade expectations are set out clearly for the development of skills, attitudes and understandings. These indicate a small number of overarching general learner expectations followed by more a detailed list of specific learner expectations as follows:

- science inquiry and problem solving – the specific expectations are set out under headings related to key features of inquiry and problem solving processes namely: focus, explore and investigate and reflect and interpret
- attitudes – the list makes reference to a range of traits important in science, such as curiosity, respect for evidence or care and respect for the environment, alongside positive dispositions that play a key role in learning, including confidence, perseverance, willingness to work with others or to take responsibility for actions
- understanding – an overview is provided for each topic indicating the kinds of experiences and contexts for learning that should be provided. The specific learner expectations indicate in considerable detail what students are expected to be able to do, know and understand. Clear links are made to inquiry and problem solving processes.

The learning experiences and goals reflect the rationale and aims of the curriculum and the program emphasis on inquiry and problem solving. They are also consistent with the philosophy of learning that emphasizes fostering curiosity, building on what children can do, communication, providing challenging activities and promoting confidence and self-reliance. Coherence is expressed through interconnections made between specific expectations related to attitudes and skills for a particular grade level and the expression of expectations for understanding.

There are no references to assessment principles or approaches within the science curriculum document. This is an important omission as match between curriculum, pedagogy and assessment is key in fostering coherence. Achievement tests for science from 2010 are available for Grade 6. These include a range of items that assess knowledge and understanding of scientific concepts and terminology, alongside questions focused on skills, for example associated with interpretation of data, identification of variables, use of charts, graphs and diagrams. The test items are linked to curriculum content (and its detailed requirements as outlined below). They reflect a concern also to assess the development of skills associated with inquiry and problem solving (within the restrictions of a written test). Attitudes could not be assessed in this way.

Scope:
As indicated above, learner expectations for scientific inquiry and problem solving cover the three dimensions of focus, explore and investigate and reflect and interpret across all elementary grade levels. In relation to scientific inquiry reference is made to key processes such as questioning, predicting, observing and communicating in Grade 1. Across the grades there is evidence of increasing expectations in relation to independence and understanding of formal procedures such identifying variables, measuring, recording and analysis of data. Children are required to explain and apply ideas and evaluate procedures and outcomes and suggest new questions for investigation. In relation to problem solving, skills associated with the identification of problems, developing strategies (such as choice of materials, steps in completing the task) and communicating and evaluating outcomes and their applications are included across all grades. In relation to attitudes, expectations for each grade refer to a similar range of attitudes and dispositions (as outlined above) with increasing focus on flexibility in

considering new ideas, sharing ideas and learning from others and critical examination of evidence.

In terms of understandings to be developed at each grade, the five topics for each year include content related to living things, materials and physical processes. Across the grades the topics tackle a range of different physical processes, for example magnetism, sound, light, electricity. Earth and space science is incorporated through topics on the seasons, rocks and minerals, weather and sky science. In each year one topic is identified as a focus for problem solving, involving building or making things (for example boats, vehicles that move) with a variety of materials and apart from Grade 1 there is a corresponding topic giving particular emphasis to science inquiry. Each topic is set out in some detail with more limited scope for local teacher interpretation than in some jurisdictions. The level of detail may also restrict depth of study.

Level of demand:
The level of demand associated with science understanding is appropriate in terms of enabling students to build on prior experiences and exploration and investigation of phenomena and events in the classroom and their immediate environment. Areas of understanding are set within specific contexts with detailed indications of variables and relationships to be investigated. In the earlier Grades (1-3) learner expectations refer to describing, making comparisons, identifying and recognizing examples and applying ideas. In Grades 4-6 there is increasing reference to explanation and description and interpretation of evidence and to scientific terminology. The demands in Grade 6 for flight and aerodynamics are considerable, as reflected in the sample Grade 6 test material.

There are also demands on both teachers and students associated with the number of specific learner expectations for each topic (around 10 in many instances) resulting in around 50 specific learner expectations for understanding for a particular grade level with the total number of specific expectations (across skills, attitudes and understandings) varying between 59 (Grade 1) and 88 (Grade 5).

The levels of demand for scientific inquiry and problem solving through technology are accessible and show features common to other jurisdictions that emphasize the development of skills in the curriculum. In addition there are distinctive emphasizes on strategies in inquiry (selection of materials, identifying sources of information, the steps involved and working with others) and the implications of investigations (such as new questions or applications).

The range of attitudes identified at each grade reflects goals for the curriculum in a number of jurisdictions and advice in professional literature in science education. Features of development identified across the grades are realistic but would demand explicit attention and guidance in terms of their assessment.
Progression:
As outlined in the sections above, some indications of progression in skills and understanding are given in the general and specific learner expectations set out for each grade.

The frameworks for science inquiry and problem solving through technology with the common strands of focus, explore and investigate and reflect and interpret aid comparison between grades and the identification of features of progression.

In relation to understanding, the sequence of topics provides some indication of coverage and progression in terms of breadth of content and experience. It is less clear how the different topics are interconnected to promote progression in particular concept areas. Some greater depth is indicated in general terms through increased references to explanation and interpretation of evidence and some greater inclusion of scientific terminology. However, as these references are incorporated into the detailed lists of specific expectations, they are rather fragmented and it is difficult to build a picture of progression.

A similar range of attitudes is included in the specific expectations for attitudes for each grade level. Progression is reflected in more detailed links to science inquiry processes and the challenges associated with development and change in ideas for example through references to "flexibility in considering new ideas" or "critical mindedness in examining evidence", alongside an increased appreciation of the positive benefits of sharing ideas and working with others.

Assessment:
Science achievement tests are currently taken at Grade 6. The exemplar test from 2010 consists mainly of multiple- choice items related to both skills and understandings in science. The test makes considerable demands in terms of literacy and knowledge of scientific terminology.

New Student Learning Assessments will be introduced to replace the current Provincial Achievement Tests, starting in September 2014 that emphasize:

- assessment as a process and its primary purpose is to improve student learning
- assessment information is available to enhance instruction
- assessment information can provide feedback on the effectiveness of the education system in meeting the needs of students and system outcomes.

There is also a suggestion that great emphasis will be placed on formative assessment within the new system.

Key competencies:
There is no explicit section related to key competencies in the current curriculum document for science or to opportunities for the development of key skills in literacy, numeracy or ICT. However, problem solving and critical thinking feature strongly in the specific learning expectations for skills, and the list of attitudes to be developed at each grade includes positive attitudes to team working.

Secondary: English education

Orientation:
This is described by Alberta Learning, in its publication *English Language Arts* (Senior High) (2003).

There are two basic aims of senior high school English language arts (ELA). One aim is to encourage in students an understanding and appreciation of the significance and artistry of literature. A second aim is to enable each student to understand and appreciate language and to use it confidently and competently for a variety of purposes, with a variety of audiences and in a variety of situations for communication, personal satisfaction and learning.

Interestingly, artistry precedes function, which is a different emphasis from other systems studied. Indeed the functional tasks set in secondary level tests are unimaginative and dull. The study of the mother tongue is firmly positioned as fundamental to being an effective citizen:

> An appreciation of literature and an ability to use language effectively enhance students' opportunities to become responsible, contributing citizens and lifelong learners while experiencing success and fulfillment in life.

There is, both in this preamble, and the assessment regimes considered later, an emphasis on Canadian literature, to give a national identity. This reinforcement of national culture is common in other systems studied:

> By studying Canadian literature, students are able to reflect on ideas and experiences of citizenship from Canadian perspectives. The study of Canadian literature helps students to develop respect for cultural diversity and common value. It is quite clear that language is perceived as being closely integrated in to the wider curriculum: language development is contextual. Students enhance their language abilities by using what they know, continuously and recursively, in new and more complex contexts and with increasing sophistication. They reflect on and use prior knowledge to extend and enhance their language abilities and understanding. By learning and incorporating new language structures into their repertoire and using them in a variety of contexts, students develop language fluency and proficiency.

In common with Ontario there is an emphasis on metacognition:

> Students who are engaged in metacognition recognize the requirements of the task at hand, reflect on the strategies and skills they may employ, appraise their strengths and weaknesses in the use of these strategies and skills, make modifications, and monitor subsequent strategies.

Coherence and Clarity:
The required learning outcomes are admirably and clearly presented in a simple, accessible document, English Language Arts (2003).

Literature:
The study of literature allows students to experience, vicariously, persons, places, times and events that may be far removed from their day-to-day experiences. Literature invites students to reflect on the significance of cultural values and the fundamentals of human existence; to think about and discuss essential, universal themes; and to grapple with the intricacies of the human condition. The study of literature provides students with the opportunity to develop self-understanding. They imagine the worlds that literature presents and understand and empathize with the characters that literature creates.

Listening and Speaking:
Oral language is the foundation of literacy. Through listening and speaking, individuals communicate thoughts, feelings, experiences, information and opinions, and learn to understand themselves and others. Oral language is used to tell a community's stories and to convey many of its values, beliefs and traditions. Listening and speaking enable students to explore ideas and concepts, as well as to understand and organize their experiences and knowledge. Students use oral language to learn, solve problems and reach goals. To become discerning, lifelong learners, students need to develop fluency and confidence in their oral language abilities. They benefit from many opportunities to listen and speak, both informally and formally, for a variety of purposes and with a variety of audiences.

Reading and Writing:
Written language is a powerful means of communicating and learning. Reading and writing enable students to extend their thinking and their knowledge and use of language, to increase their understanding of themselves and others, and to experience enjoyment and personal satisfaction.

Reading provides students with a means of accessing the ideas, perspectives and experiences of others. By using effective reading strategies, students construct meaning and develop thoughtful and critical understandings and interpretations of a variety of texts. They also use reading strategies to reconstruct the meanings of others. Writing enables students to explore, shape and clarify their thoughts and to communicate these thoughts to others. By using effective writing strategies, students discover and refine ideas, and compose and revise with increasing confidence and skill.

There is an interesting category, additional to the standard set of four skills as above, viewing and representing:

> Visual imagery is an integral part of contemporary life. By developing viewing strategies and skills, students come to understand the ways in which images may be used to convey ideas, values and beliefs. Critical viewing enables students to acquire and assess information, appreciate the experiences of others, and understand and evaluate others' ideas and perspectives. Representing may be envisioned as the expressive counterpart of viewing. Visual representation enables

> students to communicate their ideas through a variety of text forms, including posters, diagrams, photographs, collages, video presentations, visual art, tableaux and mime.

Within the category are neatly summarized learning and skills that other systems cover under terms such as ‘drama’ or ‘audio visual’:

> Representing, however, extends beyond the visual. For example, representations may have an oral component. A speaker’s tone of voice can convey, or represent, his or her feelings and attitudes. Music and sound effects that are selected to accompany a dramatic monologue, a dialogue or a readers’ theatre presentation may be representational in that they set a mood and convey an atmosphere. Representing is also manifested in print. Tables and figures that accompany informative texts may suggest spatial relationships, time sequences, and relationships between and among concepts and ideas.

These articulate, thoughtful, but rather abstract aims are supported by the delineation of specific learning aims. Only a sample is given here, as the general thrust is clear enough:

General Outcome 1:
Students will listen, speak, read, write, view and represent to explore thoughts, ideas, feelings and experiences. Students will listen, speak, read, write, view and represent to comprehend literature and other texts in oral, print, visual and multimedia forms, and respond personally, critically and creatively.

This to include:

- identify a variety of different kinds of texts, audiences and purposes for creating texts [for example, purposes could include to inform, persuade, entertain or inspire; the purpose of a print advertisement is to sell a product]
- describe character and characterization in terms of consistency of behavior, motivation and plausibility
- analyze and assess character and characterization in terms of consistency of behavior, motivation and plausibility, and in terms of contribution to theme [for example, determine the meanings suggested by a change in a character’s behavior or values]
- describe images in print and non print texts in terms of created reality and appropriateness to purpose
- analyze and assess images in print and non print texts in terms of created reality and appropriateness to purpose and audience.

Scope:
Learning aims are expressed as general outcomes. These are scaffolded. For example, on entry to senior high, General Outcome 3.2 Follow a plan of inquiry:

> Students will listen, speak, read, write, view and represent to create oral, print, visual and multimedia texts, and enhance the clarity and artistry of communication. Develop and present a variety of print and non print texts. Improve thoughtfulness, effectiveness and correctness of communication. Respect others and strengthen community. Students will listen, speak, read, write, view and represent to respect, support and collaborate with others.

There are two basic aims of senior high school ELA. One aim is to encourage in students an understanding and appreciation of the significance and artistry of literature. A second aim is to enable each student to understand and appreciate language and to use it confidently and competently for a variety of purposes, with a variety of audiences and in a variety of situations for communication, personal satisfaction and learning.

Metacognition:
Language study helps students develop an awareness of the strategies that they use to complete learning tasks successfully and to talk about, write about and represent themselves as learners. In essence, the study of language enables students to develop metacognition: it enables them to become more consciously aware of their own thinking and learning processes and to gain greater control of these processes.

The suggested literary texts show a predilection for North American and Canadian writers, but with a good level of reference to wider and classical cultures. The canon is sophisticated and demanding, for example in drama:

- All My Sons–Miller
- Bethune–Langley
- The Crucible–Miller
- Death of a Salesman–Miller
- A Doll's House–Ibsen
- The Drawer Boy–Healey
- The Glass Menagerie–Williams
- A Man for All Seasons–Bolt
- Oedipus Rex–Sophocles
- Man of La Mancha–Wasserman
- Medea–Euripides
- A Raisin in the Sun–Hansberry
- Rosencrantz and Guildenstern Are Dead–Stoppard
- A Streetcar Named Desire–Williams

Levels of Demand:
The tests follow a familiar format, using a variety of passages for comprehension, literary, journalistic, and including cartoons. The passages are carefully chosen for increasing

complexity. This example from Grade 9 indicates an increase in sophistication to the Grade 6 passages examined under assessment below.

> So there it was Friday afternoon again and I saw this girl standing by her locker. So what you doing this weekend? I asked. Not much, she said. Got a car? Yep. Got a VCR? So I went to the Video shop 'cause I like Cars and Videos and Friday nights. But the tape might as well have been Herbie Goes Into Outer Space - when I got home that night Sister Jessie had the family wheels on the road. I think I'm crossing girls off my top ten list.

The questions are suitably stretching:

The quotation "So there it was Friday afternoon again" (line 1) is used to establish:

a) suspense
b) the setting
c) point of view

The main idea purpose of this poem is to:

a) amuse the reader
b) inform the reader
c) convince the reader
d) influence the reader

On a later passage, a question requires a sophisticated level of understanding:

The statement "a helicopter eats money like an elephant eats grass" (lines 26 to 27) emphasizes the father's belief that:

a) elephants are expensive to feed
b) helicopters are expensive to operate
c) both helicopters and elephants are large
d) both helicopters and elephants consume energy

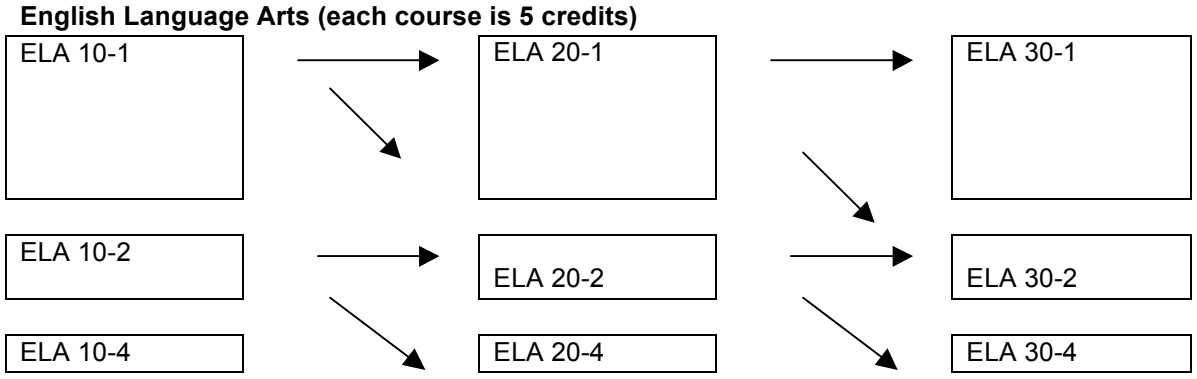
In general the comprehension passages in tests use a suitably rich variety of passages, which are a demanding read. By contrast the stimulus for free writing is rather unimaginative, with an emphasis on the familiar and the practical.

The Persuasive Writing in Context Assignment is a practical writing exercise. The assignment describes a hypothetical, real-world situation involving a proposal that requires a response in the form of a speech or a letter. Students must either accept or reject the proposal. The assignment also includes two pages of source material consisting of a variety of information

sources, which may include web pages, excerpts from print and online articles, opinion polls, emails and letters, blogs, meeting minutes, charts and graphs, photographs, and maps.

One test required students to write a persuasive piece for a familiar audience on proposed changes to their school homework policy. Practical yes, but perhaps a little dull.

Progression:



The English Language Arts (2003) publication emphasizes command of the mother tongue as vital for progression:

> As strong language users, students will be able to meet Alberta's graduation requirements and will be prepared for entry into post-secondary studies or the work place. Students will also acquire employability skills: the fundamental, personal management and teamwork skills they need to enter, stay in and progress in the world of work.

In Grade 12 students sit an Alberta Diploma. These are the provincial tests and represent half of the evidence for a Grade 12 course grade for admission to universities and colleges across Canada. Only English and Social Studies are required courses at the Grade 12. Examinations were introduced to prevent the inflation of marks by over-generous course assessment.

As an interesting benchmark for Grade 12 requirements, the University of Alberta requires one of the following:

- a final blended grade of 75% or better in English Language Arts 30-1 from Alberta
- a final or predicted grade of five or better on the International Baccalaureate English A1, A2, or a grade of 6 or better on English B
- a final or predicted grade of five or better on the International Baccalaureate English A: Literature or English A: Language and Literature
- a grade of four or better on the Advanced Placement English College Board examination

- a grade of B or better in a GCE Advanced Level (A-level) or Advanced Subsidiary Level (AS-level), GCSE, IGCSE or O-level English Language or Literature course.

Assessment:
Assessment is largely teacher centered, but fears of grade inflation post 2003 have led to the introduction of testing and the Diploma Examination. The impact has been to lower the average grade level.

The guidance in English Language Arts (2003) is:

> Teachers will assess various texts created by students for various formative and summative purposes. The use of a mixture of effective assessment strategies is encouraged; e.g., student self-assessment, peer assessment, conferencing, portfolio assessment, observation. Students will create a variety of texts for a variety of purposes and audiences. Each student will create oral texts, print texts, visual texts and multimedia texts in each course in senior high school English language arts. Also, students should be encouraged to collaborate in creating texts; and they should be encouraged to emulate models of effective texts to enhance their personal understanding of text varieties, forms and technique.

At Grade 9 students are advised:

> Your school-awarded mark is worth 50% of your final course mark and the diploma examination mark is worth the other 50% of your final course mark. Only the final course mark appears on your official transcript.

The English Language Arts 30–1 Diploma Examination has two parts. Part A: Written Response and Part B: Reading are each worth 50% of the total examination mark. Students write these two parts on different days during the January, June, and August administrations. Part A: Written Response consists of two thematically related writing assignments. The Personal Response to Texts Assignment is worth 20% of the total examination mark.

Being able to demonstrate reading comprehension skills without the use of a dictionary or thesaurus is essential for the Part B: Reading portion of the diploma examination. The reading examination requires students to draw on the understanding, knowledge and skills that they have developed as readers. Their critical reading and thinking skills – understanding of vocabulary; appreciation of tone and literary and rhetorical devices; understanding of the purpose and effect of a text creator's choices; and appreciation of the human experience and values reflected in the texts – are assessed at the level of challenge appropriate for graduating English Language Arts 30–1 students.

A Grade 6 achievement test of 2008 sets a comprehension based on a literary piece:
the narrator and his friend Raymond are in the northern wilderness during the winter. They are now returning to their cabin with the carcass of a moose tied onto a toboggan. They spot

something unusual by their cabin. This is followed by multiple choice questions, of a fairly simple, factual nature: the boys need to build a new cache because:

a) the supports on the old one are rotten the old one is too high off the ground they need to put their food on the cabin roof
b) they need to store their food inside the cabin.

A more challenging question involves a reasonably complex poem:

> A CLICHÉ
> is what we all say
> when we're too lazy
> to find another way
> and so we say
> warm as toast,
> quiet as a mouse,
> slow as molasses,
> quick as a wink.

The questions are more about the nature of language:

a) introduce new clichés
b) add variety to the writing
c) distinguish the expressions as clichés
d) suggest more appropriate expressions.

A third question is a complex, factual piece:

> RIDDLE: What grows on trees, is shaped like a melon and is full of beans?
> Answer: Cacao pods, used to make the world's favorite treat – chocolate.
> You find the yellow, red or green pods on the branches or trunks of cacao trees in warm countries like Brazil and Africa's Ivory Coast.

The questions are of a factual, but more demanding nature:

This article is written most like:

a) a report and a recipe
b) a recipe and an experiment
c) an advertisement and a report
d) an experiment and an advertisement

A variety of media are used, including visual communication:

> Examine the cartoon below and answer questions 14 to 19. In this cartoon, a girl named Ruthie and her grandpa meet a man who is painting something on a curb.

Again multiple choice questions are used, to demonstrate an understanding of the storyline, or to suggest that a problem will be solved in the cartoon, characterization (Ruthie can best be described as clever, distracted, inattentive, or enthusiastic).

Another multiple choice comprehension is a piece of complex, reflective journalism:

> When my older sister Marilyn came for a visit, she spent most of her time trying to make us over into some other kind of family. The kind you see on TV who get all excited and beam because they're having Lipton's Chicken Noodle soup for supper.

Key competencies:
There is an emphasis in the programs of study for the secondary curriculum on knowledge and employability. An example of this in practice from a Grade 9 test relates to the job description for a carpenter. The multiple choice questions that follow ask:

Which of the following groups of people would be most interested in this job?

a) people needing renovations
b) employers looking for carpenters
c) people wanting to become carpenters
d) apprenticeship program representatives.

Visual reflection is also incorporated in to the Language Arts curriculum:

> The Visual Reflection Assignment asks you to reflect upon and support your ideas and impressions regarding a photograph, illustration, drawing, poster, advertisement, or other visual text. More than one visual text may be presented.

Secondary: Mathematics

Orientation:
The mathematics curriculum sets out its main goals as preparing students to: communicate and reason mathematically, make connections between mathematics and its applications, become mathematically literate, appreciate and value mathematics, make informed decisions as contributors to society. These goals treat mathematics as enabling the individual child to engage with culture and contribute to social endeavor. Mathematics is not given a privileged status or rationale beyond other core subjects: there is no reference to a particular economic or political return for mathematics and science. There is an unusual explicit recommendation that mathematics teachers should encourage students to "take risks" in mathematical problem

solving and this is compatible with the Inspiring Education qualities of Engaged Thinker and Entrepreneurial Spirit.

The curriculum leads with an expression of its constructivist pedagogy as a set of beliefs about students and mathematics learning, and this remains the same for all grades. Claims about learning are referenced to academic and policy literature. Learning is treated as an active individual process of developing meaning through experiences, with significant roles for prior knowledge, manipulative and visual resources, discussion and an atmosphere conducive to risk-taking. The affective domain is highlighted as making a positive contribution to all students' perseverance and curiosity. One section of the introduction considers first nation, Méti and Inuit students. It outlines the oral and contextualized learning practices of first nation, Méti and Inuit students with implications that are compatible with the approach to mathematics learning but without adding operational detail.

Coherence and Clarity:
The curriculum is set out grade by grade for lower secondary (Grade 7-9) and then divides into three programs of study for Grades 10-12, each of which is specified by grade (unlike Japan with no differentiation and Massachusetts with no grade division). The least demanding of these sequences (10-3, 20-3, 30-3) is designed for students pursuing apprenticeship programs or direct entry into the workforce, rather than university study and starts in Grade 10. The most demanding sequence (10C, 20-1, 30-1) is designed for students who will study calculus at university level, and it separates in Grade 11 from the -2 sequence (for those whose university study will not involve calculus) (Alberta MOE 2013, p39).

Grades 7-9:
The content for each of the Grades 7-9 is set out in four strands (number, patterns and relations, shape and space, statistics and probability). Each has one or two General Outcomes that are further subdivided into Specific Outcomes, and then exemplified by Achievement Indicators.

The common general outcomes provide continuity across Grades K-9 but are sufficiently vague (for example, develop number sense) in that they do not indicate any pedagogic or curricular approach to the mathematics. As a covering set, the general outcomes constitute an unusually informal partition of the mathematics content for Grades 7-9 because of their origins in K-6 work. For example functions and graphs appear within *Use patterns to describe the world and to solve problems*, while proportion appears within *Develop number sense*. These are coherent placings but do not reflect the significance appropriate for those topics at that stage.

Specific outcomes are particular to each grade, and there are approximately 20 per grade. They frequently require students to demonstrate understanding of a concept or relationship, and the achievement indicators suggest the scope of this understanding (with anywhere from 2-10 indictors per outcome). There is a broad sense of progression without any clear pathways, for example, demonstrate an understanding of ratio … in Grade 6, is followed in Grade 8 by solve problems involving ratio..., but Grade 7 does not mention ratio problems at all although it

develops the associated concepts of percentages and fraction operations. There are no specified pedagogic materials. The introduction suggests that teaching should be integrated within and across strands. Overall, the curriculum gives enough detail to make it clear to teachers at which grade the main topics should be introduced, and with what range of mathematical objects (for example, on integers, for linear functions only, etc). It does not specify in detail the pedagogic approach that should be taken. It is clear from the achievement indicators that understanding is taken to involve more than computational accuracy, for example, including solving problems, explaining models and devising pictorial and symbolic representations. However, there are few details of exactly which representations, contexts or models should be used. This indicates a need for teachers' professional knowledge and reduces the potential for test predictability from the curriculum alone.

Grades 10-12/ Sequences 1-3:
The content in these grades is organized into strands whose names reflect the more abstract nature of the mathematics involved:

- number
- algebra
- logical Reasoning
- geometry
- measurement
- trigonometry
- relations and functions
- permutations, combinations and binomial theorem
- probability
- statistics
- mathematics research project

There is inconsistency in whether these strands continue across grades. For example simple trigonometric ratios appear in measurement in Grade 10 of the pre-calculus sequence 1 but in a trigonometric reasoning strand of their own for Grades 11 and 12. Only one of the general outcomes – develop algebraic and graphical reasoning through the study of relations – is present across all grades for sequences 1 and 2. One strand-outcome combination is not a mathematical content topic at all but a task type and process, Mathematics Research Project: develop an appreciation of the role of mathematics in society. Overall, the strands and general outcome levels appear difficult to use as a coherent organizational structure although they may reflect pragmatic or traditional divisions.

There are 11-24 specific outcomes per grade, more for the pre-calculus sequence 1 and fewer for the non-university sequence 3. The outcomes have more precision in their level of detail than in K-9: they would permit teachers to organize in which grade to teach what topic *and* the detailed range of specific skills that should be mastered (with for example 57 achievement indictors related just to linear functions in course 10-C). They still include tasks of unspecified

complexity (especially in relation to problem solving), reducing the potential for test predictability from the curriculum alone.

The secondary curriculum started from a coherent set of goals emphasizing attitudes and confident use of mathematics, including mathematical processes. On the whole, these goals are *not* elaborated in the later specification of content and outcomes, despite an attempt via cross-referencing to processes. There are two exceptions. The first is the inclusion of a mathematics project for grade in 11 in 10-2 which emphasizes communication and an appreciation of enquiry mathematics. It is not clear how important this project is in the course schedule or assessment. The second is the design of the whole non-university sequence 3 with its emphasis on mathematical literacy and applications.

Scope:
The structure of the curriculum has been described above. Apart from the non-university sequence 3, there is a usual movement from the number-based topics of earlier work to algebraic and graphical reasoning. Measurement, data handling and probability appear as minor themes throughout. Unusually, some aspects of number theory are explicitly treated in early secondary, taking notions of divisibility beyond calculation aides, for example, understand the relationship between positive terminating decimals and positive fractions and between positive repeating decimals and positive fractions (Grade 7).

Modeling repeatedly appears as an explicit outcome related to different representations rather than merely being implied in an outcome of conceptual understanding or problem solving. For example: demonstrate an understanding of preservation of equality by modeling preservation of equality, concretely, pictorially and symbolically (Grade 7); model and solve, concretely, pictorially and symbolically, problems that can be represented by linear equations of progressively more complex sorts in Grades 7, 8, 9; model, record and explain the operations of addition and subtraction of polynomial expressions, concretely, pictorially and symbolically (Grade 9). This emphasis is reflected in some distinctive PAT questions at Grade 9.

There is a specific outcome related to proof at Grade 11 (course 20 2; analyze and prove conjectures, using inductive and deductive reasoning, to solve problems) and it is made clear throughout Grades 11 and 12 where inductive or deductive reasoning is expected.
There is an early emphasis on understanding different language and representations of rate of change/slope of graphs in preparation for calculus. This occurs in Grade 10 before a wide range of algebraic functions has been met.

Graphing of quadratics comes relatively late in the curriculum, not until Grade 11 even for the pre-calculus course. When these students do move to non-linear functions they meet a wide range in 30-1, not only the rational functions but – more unusually – the radical functions. Although there is no calculus, there is a thorough algebraic study of maxima and minima of quadratic and even trigonometric functions, and transformation by simple mappings of x and $f(x)$.

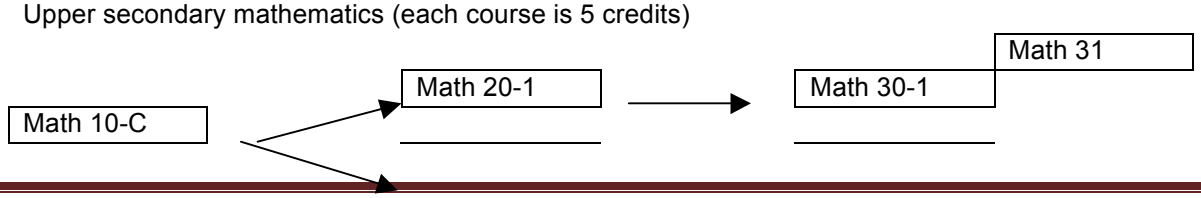
Study of the classic results of Euclidean Geometry, for example, theorems related to parallel lines and transversals, circles and tangent, are omitted for the pre-calculus sequence 1, although present in the other sequences.

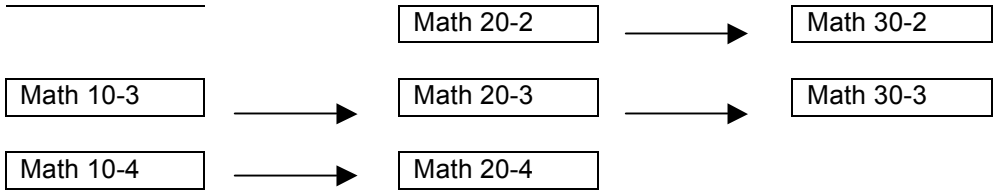
The content of sequence 3 is notably different from the other two sequences, with a greater emphasis on meeting problems in contexts: problems that involve spatial reasoning and measurement, personal and business finance, probability and data handling. Algebra in this sequence concerns use and manipulation of formulas rather than proof, number theory or generalization. There is overlap with the other courses in the geometry and statistics content, with some topics met a grade earlier in sequence 3 than in sequence 2. This appears to result from the increased focus on developing algebraic fluency in course 10C and would make it impractical for students to change from sequence 3 to 2 after Grade 10.

Levels of Demand:
The curriculum is not differentiated at Grades 7-9. There is a degree of similarity in the topics met at each grade, with students extending previous concepts of number operations or pattern finding to new mathematical objects. Within these related topics the progression between grades corresponds to research findings about students' learning facility. There is a notably slow progression in the algebraic complexity of the linear equations that students are expected to meet, represent and model situations with. In Grade 7, these are of the form $ax = b$, $ax + b = c$, with integer coefficients a, b, c. In Grade 8 this extends only to $x/a = b$, $x/a + b = c$ with $a \neq 0$, and $a(x + b) = c$, still with integer coefficients a, b, c. This makes sense from the perspective of modeling contextual situations, because the type of operation implied in the word problem has changed from multiplication to division. However, the restriction would make it hard to explore the whole space of linear functions from a graphical perspective, and could lead to a lack of challenge for students with algebraic fluency. In Grade 9 students do progress to studying linear equations with rational coefficients in various forms, but the slow progression means that they meet these at the same time as quadratic expressions.

The diploma tests designed for assessment at Grade 12 include written response items that have a particularly high level of demand in interpreting contextual information and goals in order to select the appropriate mathematical procedures. The standard of algebra required in course 30-2, that is, for university-track students is good.

Progression:
The curriculum is written as a continuum from Grades K-9 with a break, and different routes are identified for Grades 10-12. There is smooth progression between the different grades within each pathway, with the chosen topics on the whole being revisited at a higher level in each grade.





Assessment:
Mathematics achievement tests at Grade 9 provide feedback to schools, students and parents on individual students' achievements. Approved non-graphical calculator use is permitted, although many problems require students to choose operations or expressions rather than evaluate solutions. The tests sample the curriculum from Grades 6 -9. The blueprint for the tests includes a breakdown into items at low, medium and high complexity and the ratio of these is approximately 32:52:16. The percentage of items in each of the four main content strands at Grades 7-9 varies between years although statistics/probability has a lower weighting (around 10%). There is a mix of numerical response and multiple choice items.

There is not always a direct match to specific outcomes or achievement indicators. For example:

> Which pair of expressions below are equivalent for all values of x?
>
> a) $-3x + 4x^2 + 2$ and $4x^2 - 2 + 3x$

is explicitly allocated (p3) as matching Grade 8 patterns and relations 2 (concerning linear equations). However, this seems more relevant to Grade 9 patterns and relations 5, concerning polynomials. While this may be an error, it could also suggest that there is more attention to overall coverage of the strand than to the grade by grade subdivisions.

The two diploma tests (30 -1 and 30-2) at Grade 12 include numerical response and multiple choice items. Unpublished anchor items secure consistency over time. Approved calculators are permitted. They sample only the Grade 12 curriculum, three strands or each sequence, and in both tests the area including algebra and functions has a majority weighting. Trigonometry has the second weighting for pre-calculus students (29%) and probability for sequence 2 (33%). Seven out of the 40 items are "excellence" questions that are particularly demanding (intended for students who achieve over 80% overall). The assessment is closely aligned with the problem solving nature of the curriculum in that the items include conceptual, procedural and problem solving questions with an emphasis in the ratio 34:30: 36. Again, this shows the high demand for students to read diagrams and word problems in English or French and interpret them mathematically.

Key competencies:
The key processes of mathematics that students are expected to meet are:

- use communication in order to learn and express their understanding

- make connections among mathematical ideas, other concepts in mathematics, everyday experiences and other disciplines
- demonstrate fluency with mental mathematics and estimation
- develop and apply new mathematical knowledge through problem solving
- develop mathematical reasoning
- select and use technology as a tool for learning and for solving problems
- develop visualization skills to assist in processing information, making connections and solving problems.

These are cross-referenced throughout in a rather superficial matching but in fact several of these themes permeate the specification of content and the assessment. Notable among these are problem solving, which has a significant emphasis, and visualization, which is encouraged by the use of diagrams. There is no evidence of required technology use in the curriculum although graphic calculators are expected for diploma test.

Secondary Science

The vision for science including biology is stated as:

> The secondary science program is guided by the vision that all students, regardless of gender or cultural background, are given the opportunity to develop scientific literacy. The goal of scientific literacy is to develop in students the science-related knowledge, skills and attitudes that they need to solve problems and make decisions and, at the same time, to help students become lifelong learners who maintain their sense of wonder about the world around them.

The goals for high school science, including biology, are stated as:

- encourage students at all grade levels to develop a critical sense of wonder and curiosity about scientific and technological endeavors
- enable students to use science and technology to acquire new knowledge and solve problems so that they may improve the quality of their lives and the lives of others
- prepare students to critically address science-related societal, economic, ethical and environmental issues
- provide students with a foundation in science that creates opportunities for them to pursue progressively higher levels of study, prepares them for science-related occupations and engages them in science-related hobbies appropriate to their interests and abilities
- develop in students, of varying aptitudes and interests, a knowledge of the wide spectrum of careers related to science, technology and the environment.

The aims and vision for science education are clear, balanced and coherent. They are also distinctive, with an unusually strong leaning toward sustainable futures. Sustainability and responsibility is specifically mentioned in the opening statement and stewardship is mentioned

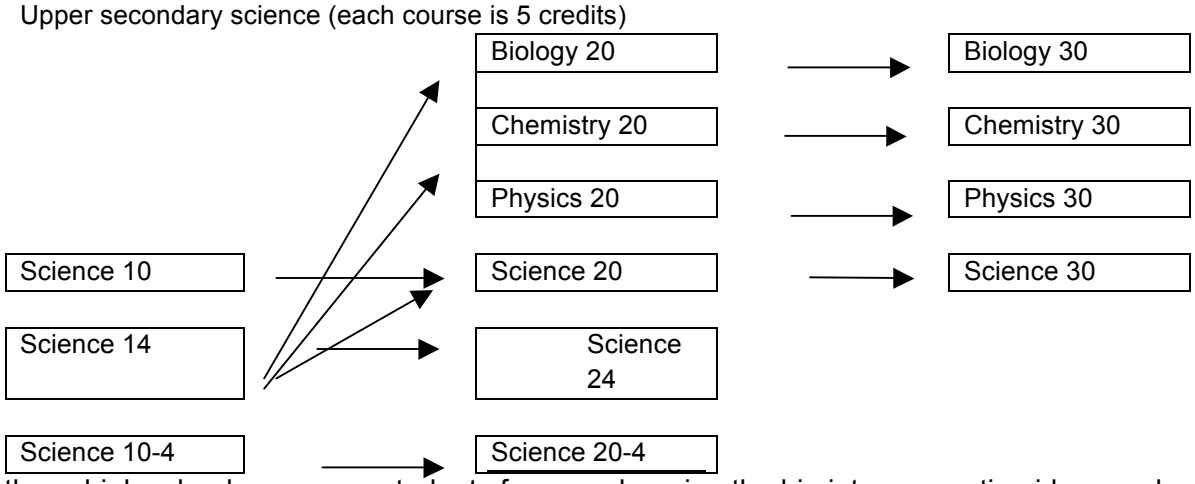
later as an outcome of the curriculum. Knowledge, skills and attitudes are well balanced. There is a strong sense of individual flourishing in the curriculum goals – the first of which states that the curriculum should encourage a "critical sense of wonder" through science and the study of the natural world. The aim of stimulating interest and lifelong learning is mentioned, and there is concern for inclusion and access to all. There is some interest in a curriculum for employability hinted in the word "careers" but the tone of the vision, aims and goals is more toward sustainable futures and individual flourishing. This indicates a clear and robust educational philosophy behind the curriculum.

A further level of detail is provided in the program organization and format, which explains there are both general and specific outcomes and lists general outcomes for both concepts and skills, under three headings of Nature of Science, Science and Technology and Social (STS) and Environmental Emphasis for example:

> Canadian society supports scientific research and technological development that helps achieve a sustainable society, economy and environment science from Kindergarten to Grade 9 is divided into three topics: life science, earth science and physical science. In Grade10 a further strand is added, that of chemistry.

The same framework was used for the development of all these senior high science programs. The expected student knowledge, skills and attitudes are approached from a common philosophical position in each science course.

From Grade 10 – Grade 12 a variety of pathways are possible:



In these high school programs, students focus on learning the big interconnecting ideas and principles. These ideas, or major themes, originate from science knowledge that transcends and unifies the natural science disciplines. These themes include change, diversity, energy, equilibrium, matter and systems; the process by which scientific knowledge is developed, including the role of experimental evidence; and the connections among science, technology and society.

These programs are designed to place an increased emphasis on developing methods of inquiry that characterize the study of science. Students will further their ability to ask questions, investigate and experiment; gather, analyze and assess scientific information; and test scientific principles and their applications; and develop their problem-solving ability.

Each science program is based on four foundations:

- foundation 1
    - attitudes – students will be encouraged to develop attitudes that support the responsible acquisition and application of scientific and technological knowledge to the mutual benefit of self, society and the environment
- foundation 2
    - knowledge – students will construct knowledge and understandings of concepts in life science, physical science and earth and space science, and apply these understandings to interpret, integrate and extend their knowledge

- foundation 3
    - science, technology and society (STS) – students will develop an understanding of the nature of science and technology, the relationships between science and technology, and the social and environmental contexts of science and technology
- foundation 4
    - skills – students will develop the skills required for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, for working collaboratively and for making informed decisions.

A detailed framework is provided with details of attitude outcomes, units of study, themes, key concepts and outcomes.

Two levels of outcomes are provided in each unit:

- general outcomes: these are the major outcomes in the unit that students are to demonstrate over the course of their learning
- specific outcomes: these are detailed outcomes that delineate the scope of each general outcome and the unit. Specific outcomes for knowledge; science, technology and society (STS); and skills are identified.

All Grade 9 students sit Provincial Achievement Tests (PATs) in science. The purpose of the PATs is to:

- determine if students are learning what they are expected to learn
- report to Albertans how well students have achieved provincial standards at given points in their schooling
- assist schools, authorities, and the province in monitoring and improving student learning.

The science PATs in 2010 took the form of an objective 60 minute, 50 item objective test with 24 questions testing knowledge and 26 questions testing skills (such as modelling, calculating and reasoning). The test reviewed had items of variable demand, providing good content coverage, but limited by the multiple choice format, to assessing a narrow range of the wide goals of the curriculum. It is possible that the multiple-choice test format cannot assess validly the full-range of curriculum objectives in a valid manner.

Secondary: Earth Science

Coherence and Clarity:
The learning goals (for knowledge, skills and attitudes) are very clear and specific. There is some supporting material and advice with exemplification of how learning outcomes may be achieved. This is embedded within the main curriculum documents. There is clarity and steer in the stated outcomes, phrased as "students will..." (that is, what students will learn or do). There is a high level of specificity, and the assessment material supports the specific learning goals. However, assessment appears to be entirely multiple choice or single phrase answers. This appears to narrow the means of assessment and is not entirely coherent with the more nuanced aspects of the earth science curriculum.

Scope:
The curriculum has good balance between knowledge, skills and attitudes. A strong feature is outcomes expressed as what students are able to "do" as well as the knowledge they gain. The curriculum sets out to develop critical understanding, and this is reflected in the content of the curriculum. The earth science curriculum is embedded and integrated into science. There may also be elements of earth science elsewhere in the curriculum (such as social science of geography) but in the science curriculum a broad range of earth science is covered, including emphasis on plate tectonics and earthquakes, geology, glaciation, water cycle and ecosystems. Rather than earth science being separated from science this curriculum gives a heading of science to apply biology, chemistry and physics to the context of the earth, Canada and how people and nature interact. Science is thus explored through an environmental lens. Fieldwork (stated explicitly) appears to be missing from the earth science curriculum.

Levels of Demand:
The curriculum has a challenging conceptual and knowledge content. There is much potential to stretch and challenge young people here and the curriculum is ambitious in the depth of understanding aimed for. There is plenty of detail given in the expected learning outcomes, and students will be challenged if they are to reach all outcomes – both in the quantity of content to learn and the level of conceptual understanding. There is some concern over how the assessment arrangements support challenge, however. There appear to be only multiple choice/ single phrase answer questions, and the scope and depth of the curriculum warrants other ways of assessment, such as by extended individual investigation or demonstrating planning and problem solving, such as by extended writing in answer to a nuanced question.

Progression:
There is good progression between the two main stages of secondary education and the curriculum ties together and builds well. The detailed statements of outcomes support progression. The concepts and themes of the curriculum, such as ecosystem, plate tectonics and weathering/ erosion, are established in the lower secondary phase and built upon in the higher stage, in a coherent way. There is some revisiting of content and concepts, but at a deeper level, so this exemplifies the idea of a spiral curriculum. Attention to contexts (such as specific places) also supports progression in breadth. There is some question over the wider role of assessment, however, which seems to be rather neglected in the curriculum design. The summative multiple choice questions are carefully designed to test knowledge, but how far they test deep understanding, attitudes and skills (all key aims of this curriculum) is uncertain.

Assessment:
As mentioned above there is some concern over how the assessment arrangements support challenge, however. There appear to be only multiple choice/ single phrase answer questions and the scope and depth of the curriculum warrants other ways of assessment, such as by extended individual investigation or demonstrating planning and problem solving, such as by extended writing in answer to a nuanced question. The wider role of assessment (formative as well as summative) seems to be rather neglected in the curriculum design. The summative multiple choice questions are carefully designed to test knowledge, but how far they test deep understanding, attitudes and skills (all key aims of this curriculum) is uncertain. These may be covered in teacher assessment.

Key competencies:
These are given as:

- initiating and planning
- performing and recording
- analyzing and interpreting
- communication and teamwork
- interest in science
- mutual respect
- scientific inquiry
- collaboration
- stewardship.

There is ample opportunity to develop these competencies through the curriculum, in the knowledge content, skills and activity approaches through which students learn – all stated or used to exemplify expectations, in the curriculum documents. However, the lack of a clear fieldwork element and an apparently narrow mode of assessment limit confidence in how far theses competencies can be achieved.

Secondary: Biology

Coherence and Clarity:
The life science curriculum provides clear, specific goals, split between scientific skills and content. There is biological content in the science program of study.

- science 14: investigating matter and energy in living systems
- science 24: disease defense and human health
- science 10: cycling of matter in living systems
- science 20: changes in living systems
- science 30: living systems respond to their environment

The biology programs of study are:

Biology 20 consisting of four units of study:

- energy and matter exchange in the biosphere
- ecosystems and population change
- photosynthesis and cellular respiration
- human systems.

Biology 30 consisting of four units of study:

- nervous and endocrine systems
- reproduction and development
- cell division, genetics and molecular biology
- population and community dynamics.

Each topic has a broad overview linking it to prior learning and the overall framework outcomes. Content is described by a general outcome, for example, General Outcome 1 – students will explain the constant flow of energy through the biosphere and ecosystems.

Each general outcome is built from specific outcomes for knowledge, for example, explain, in general terms, the one-way flow of energy through the biosphere and how stored energy in the biosphere, as a system, is eventually "lost" as heat; for example through photosynthesis/chemosynthesis, cellular respiration (muscle-heat generation, decomposition), energy transfer by conduction, radiation and convection, together with specific outcomes for Science, Technology and Society (STS), for example: explain that the process of scientific investigation includes analyzing evidence and providing explanations based upon scientific theories and concepts; evaluate the evidence for the influence of ice and snow on the trapping of solar energy (albedo effect) and hypothesize on the consequences of fluctuations for biological systems; explain how metabolic heat release from harvested grain can be reduced by drying processes prior to grain storage and explain the scientific principles involved in this

technology; explain, in terms of energy flow, the advantage of vegetarianism in densely populated countries.

The program of study provides links to identify opportunities to develop relevant specific skills from the ICT program of study, which are regarded as required learning outcomes.

Links to the mathematics program of study identify mathematical concepts and skills related to science content in the science units of study. The mathematics links identify where similar concepts and skills are developed in the mathematics programs of study to support making connections between mathematics and science learning, but are not science learning outcomes.

Together, these components provide clear guidance to teachers as to how the different requirements should be incorporated into the learning and teaching environment at a level that is appropriate to that grade.

Scope:
There are a variety of pathways through high school science and biology. For most students the starting point is Science 24, then Science 10 as shown in the diagram above. The primary focus is the development of the required skills; specific outcomes for Science, Technology and Society (STS) in the contexts provided by the content learning outcomes.

The curriculum is developed from the four program foundations. Each integrates different aspects of the skills and content development. A clear definition of depth and breadth is provided for each of the four foundations.

The biology content for Biology 20 is made up from four units:

- energy and matter exchange in the biosphere
- ecosystems and population change
- photosynthesis and cellular respiration
- human systems.

Each unit has an overview, for example:

> Unit A: The constant flow of energy and cycling of matter in the biosphere leads to a balanced or steady state. This balance is achieved through various biogeochemical cycles and the processes of photosynthesis and cellular respiration.

A set of key concepts are listed, for example:

- biosphere
- equilibrium
- trophic levels

- food chains, food webs and ecological pyramids (energy, biomass and numbers)
- carbon, nitrogen, oxygen and phosphorus cycles
- water properties.

The intended level and scope of treatment is defined by the outcomes, for example, Unit A General Outcome 2: students will explain the cycling of matter through the biosphere.

Each general outcome is then described in detail in terms of specific outcomes for knowledge, for example, students will explain and summarize the biogeochemical cycling of carbon, oxygen, nitrogen and phosphorus and relate this to general reuse of all matter in the biosphere; and specific outcomes for STS, for example, explain that science and technology have both intended and unintended consequences for humans and the environment; discuss the influence of human activities on the biogeochemical cycling of phosphorus, sulfur, iron and nitrogen:

- feedlot operations
- composting
- fertilizer applications
- waste and sewage disposal
- vehicle and refinery emissions
- acid deposition
- persistent organic pollutants etc.

Looking at the range of general and specific outcomes and the learning outcomes described in them, there is a good balance of breadth and depth, appropriate these courses.

Levels of Demand:
The level of demand is appropriate for this course in biology. This is illustrated by the way many outcomes build on from previous grades, previous programs, units and within the topics.

Unit C: Photosynthesis and Cellular Respiration. This program of study states that this builds prior knowledge from:

- science 10, unit c: cycling of matter in living systems
- science 10 unit c includes the knowledge outcome: describe how the cells of the leaf system have a variety of specialized structures and functions; i.e. epidermis including guard cells, palisade tissue cells, spongy tissue cells, and phloem and xylem vascular tissue cells to support the process of photosynthesis.

The knowledge outcomes in Biology 20, unit C, are illustrated by:

- explain, in general terms, how glucose is oxidized during glycolysis and the Krebs cycle to produce reducing power in NADH and FADH; and describe where in the cell these processes occur

- explain, in general terms, how chemiosmosis converts the reducing power of NADH and FADH to store chemical potential energy as ATP; and describe where in the mitochondrion these processes occur
- distinguish, in general terms, between aerobic and anaerobic respiration and fermentation in plants, animals and yeast
- summarize and explain the role of ATP in cellular metabolism.

Each unit shows clear increase in demand in terms of the knowledge content and this is exemplified by the use of command words, with *describe* in Science 10, and *explain* in Biology 20.

Progression:
A topic summary chart is provided that shows the progression in topics from Kindergarten to Grade 12. It is quite easy to then track these in the program of study using the online search engine provided by Learn Alberta. For example:

- G1 needs of animals and plants
- G4 Plant Growth and Changes
- G7 plants for food and fiber
- science 10 cycling of matter in living systems
- biology 20 photosynthesis and cellular respiration.

The program of study provides information on the prerequisite learning outcomes at the unit level, for example, Unit D: Human Systems requires prerequisite knowledge from:

- G8 science, unit b: cells and systems
- science 10, unit c: cycling of matter in living systems.

Although no documentation has been found for a more detailed progression, the information provided in the documentation and online makes it very straightforward to track progression for any theme or topic.

Success in Biology 30 requires the successful completion of Science 10 and Biology 20, which develop the requisite knowledge and skills.

Assessment:
Grade 9 students all sit Provincial Achievement Tests (PATs) in science. The tests take the form of a 60 minute 50 item objective test, 24 testing knowledge and 26 testing skills (in 2010). In Grade12 students sit diploma examinations in Science 30 or Biology 30. Both take the form of objective tests.

Multiple-choice items are of two types: discrete and context dependent. A discrete item stands on its own without any additional directions or information. It may take the form of a question or an incomplete statement. A context-dependent item provides information that is separate from

the item stem. Most of the multiple-choice items in the diploma examination are context dependent.

Numerical-response items are of several types, including: calculating numerical values; expressing ratios; selecting structures, functions, or statements from a diagram or a list; matching structures, functions, or statements from a diagram or a list; and determining the sequence of listed events.

The Science 30 diploma examination consists of 55 machine-scored items that are worth 100% of the examination mark.

Science 30 examinations cover the following general outcomes of which 20-30% are biology-based:

- circulatory and immune systems 10–15%
- genetics 10–15%
- environmental chemistry 20–30%
- field theory and electrical energy 13–18%
- electromagnetic spectrum 7–12%
- energy and the environment 20–30%.

The Biology 30 diploma examination consists of 48 multiple-choice and 12 numeric items that are machine-scored and worth 100% of the examination mark and also contains embedded anchor items in order to maintain consistent standards over time.

The examination covers the following general outcomes:

- nervous and endocrine systems 20−25%
- reproductive systems and hormones 10 −15%
- differentiation and development 5 −10%
- cell division and genetics 25 −30%
- molecular biology 10 −15%
- population and community dynamics 15 –20%.

Each item is clearly linked to a learning outcome.

The data for the released diploma examination items in the 2012 paper show that there were 26 comprehension/application items, nine knowledge items and one higher mental activities item. The difficulty ranged from 41.4% to 87.8%. There was no report of the remaining 24 items, but at least some must have been anchor items. There is a mix of relative demand across the items, and this is likely to lead to a reasonable discrimination among the students.
There is almost no testing of the scientific inquiry skills outcomes and these are not referenced in the reporting categories.

The document *30Biology 2013 – 2014 Diploma Examinations Program Information Bulletin* provides updated guidance on cognitive expectations in the program of study. It explains the use of the command words. Some command words require students to identify structures or recall facts, and outcomes or portions of outcomes with these verbs are classified as knowledge (K). Some require students to make connections between concepts or to take information they already know and apply it to new contexts. Outcomes with these verbs are classified as comprehension and application. Other command words require students to build new connections, integrate several concepts, as well as analyze, evaluate, or synthesize information. Outcomes with these verbs are classified as higher mental activities (HMA).

Key Competencies
While the program of study tends not to use the word competence, there are a number of generic skills that are promoted throughout the science curriculum program of study. These skills focus on scientific inquiry:

- initiating and planning
- performing and recording
- analyzing and interpreting
- communication and teamwork.

Secondary: Chemistry

Coherence and Clarity:
The Alberta curriculum presents as rather more complicated than that of other jurisdictions. The curriculum documents were written in the mid-2000s and then updated around 10 years later. The programs of study are substantial documents: the Chemistry 20-30 program of study contains 68 pages of generic and specific material with the first chemistry content appearing on page 14.

In terms of coherence, the four foundations are common across the curriculum and the different specifications (Science 10, Chemistry 20-30, etc.) have similar formats although they are all quite detailed. A further level of detail is provided in the *program organization and format,* which explains that there are both general and specific outcomes and lists general outcomes for both concepts and skills, under the three headings of nature of science, STS and social and environmental emphasis for example “society supports scientific and technological development by recognizing accomplishments, publishing and disseminating results and providing financial support.”

Scope:
A list of “attitude outcomes” is included at the beginning of each of the 20-level and 30-level courses. These specific outcomes are to be developed throughout the particular course in conjunction with the specific outcomes for knowledge, STS and skills listed within each unit of study. Four units of study are outlined for each course. Each unit in the 20-level and 30-level

courses includes the following components: themes; overview; focusing questions; key concepts; outcomes; examples; STS emphases; additional links; links to mathematics. In terms of the outcomes, two levels are provided in each unit: general outcomes and specific outcomes.

Science 10
There are four units in the Science 10 curriculum:

a) energy and matter in chemical change
b) energy flow in technological systems
c) cycling of matter in living systems
d) energy flow in global systems.

The emphasis of units a) and c) is on the nature of science, unit b) focuses on science and technology and unit d) emphasizes social and environmental contexts. For each of the three emphases, the curriculum identifies a large number of concepts and skills to be addressed.

Chemistry in Science 10 links to the curriculum studied in Grade 9 (Unit B: Matter and Chemical Change). Science 10 Unit A) Energy and Matter in Chemical Change focuses on understanding chemical changes. As students explore the properties of molecular and ionic compounds, including acids and bases, they begin to appreciate the need for a classification scheme and a system of nomenclature. Students classify, name compounds and write balanced chemical equations to represent chemical changes. As well, students are introduced to the law of conservation of mass and the mole concept. The three overarching outcomes for STS and knowledge are:

Students will:

1. describe the basic particles that make up the underlying structure of matter, and investigate related technologies

2. explain, using the periodic table, how elements combine to form compounds, and follow IUPAC guidelines for naming ionic compounds and simple molecular compounds

3. identify and classify chemical changes, and write word and balanced chemical equations for significant chemical reactions, as applications of Lavoisier's law of conservation of mass.

Each of these outcomes is illustrated by a number of sub-outcomes. So, for example, the detailed objectives for the first outcome are:

- identify historical examples of how humans worked with chemical substances to meet their basic needs (e.g., how pre-contact First Nations communities used biotic and abiotic materials to meet their needs)

- outline the role of evidence in the development of the atomic model consisting of protons and neutrons (nucleons) and electrons; i.e. Dalton, Thomson, Rutherford, Bohr
- identify examples of chemistry-based careers in the community (e.g., chemical engineering, cosmetology, food processing) .

The *Skill* outcomes focus on scientific inquiry:

- initiating and planning
- performing and recording
- analyzing and interpreting
- communication and teamwork.

The *Attitude* outcomes are:

- interest in science
- mutual respect
- scientific inquiry
- collaboration
- stewardship
- safety.

Science 20
The four Science 20 units are:

a) chemical changes
b) changes in motion
c) the changing earth
d) changes in living systems.

Unit A builds on Science 10, Unit a) Energy and Matter in Chemical Change. The focus of the unit is on chemical and energy change. In order for students to understand how numerous useful materials are produced, they need to develop an understanding of concentrations of aqueous solutions, oxidation-reduction (redox) processes and the characteristics of hydrocarbons. Economically important industries in Alberta and other parts of Canada are based upon the application of chemical principles. The three major outcomes are:

- investigate aqueous solutions to determine conductivity and to calculate concentration
- explain oxidation, reduction and spontaneity and apply this knowledge to voltaic and electrolytic cells and to industrial processes
- describe the properties of simple hydrocarbons and describe hydrocarbon-based industrial processes that are important in Alberta.

Chemistry 20

The four units of study are:

a) the diversity of matter and chemical bonding
b) forms of matter: gases
c) matter as solutions, acids and bases
d) quantitative relationships in chemical changes.

The major focus of Unit A is on relating theories about bonding to the properties of matter and to developing explanations and descriptions of structure and bonding through scientific models. Students learn about the diversity of matter through the investigation of ionic compounds and molecular substances. Unit B focuses on expanding students' knowledge of the nature of matter through the investigation of the properties and behavior of gases. Unit C focuses on the nature of matter through an investigation of change in the context of solutions, acids and bases. Unit D focuses on chemical change and the quantitative relationships contained in balanced chemical equations. Students are required to use stoichiometric principles and mathematical manipulation to predict quantities of substances consumed or produced in chemical reaction systems.

Chemistry 30
The four units of study are:

a) thermochemical changes
b) electrochemical changes
c) chemical changes of organic compounds
d) chemical equilibrium focusing on acid-base systems.

In Unit A students study energy as it relates to chemical changes and quantify the energy involved in thermochemical systems, and consider the various aspects of energy use on society. In Unit B they study electrochemical change and analyze the matter and energy changes within a system. Unit C serves as an introduction to organic chemistry and students learn about common organic compounds and describe their properties and reactions. The significance of organic chemistry, in the context of technological applications and quality of life, is explored. In Unit D, the concept that chemical change eventually attains equilibrium is developed, followed by a focus on the quantitative treatment of reaction systems involving acid-base solutions.

Levels of demand:
The programs of study appear quite daunting in their complexity compared with those of many other jurisdictions. While the level of knowledge and skill outcomes broadly match other curricula, the breadth of study required to address the four foundations, the three emphases and the ICT outcomes would seem to be demanding. Teachers are faced not only with teaching the chemistry content but also have to develop their students' appreciation of the nature of science, the relationship between science and technology and the social and environmental aspects of the subject.

The non-statutory examples provided in the program of study illustrate the level of demand that is expected. For example 30 C.1.1:

- explain how science and technology are developed to meet societal needs and expand human capability
- describe where organic compounds are used in processes and common products, such as in hydrogenation to produce margarine and esters used as flavoring agents
- describe Aboriginal use of organic substances for waterproofing, tanning, dyeing, medicines, salves and insect repellents.

The examples are meant to be illustrative but, taken together, they provide a challenging amount of material to be covered by teachers.

Progression:
Progression is clear in the documentation for Grade 7-Grade 9 through the common formats and the descriptions. Progression through the alternative routes in senior high is less clear. Specific references to prior study expected are provided in each course description, but, because of the complexity of the different dimensions of the outcomes, it is difficult to be sure that progression would be unproblematic.

Assessment:
Grade 12 students sit diploma examinations in Science 30 or Chemistry 30. The Science 30 examinations contain approximately 20 – 30% chemistry.

The 2012 Chemistry 30 diploma examination consisted of 44 multiple choice and 16 numerical response questions. The questions often provide new information to students such as "ascorbic acid, a powerful antioxidant in the human body, can be isolated from citrus fruits, rose hips, or spruce needles." The questions rarely test students' higher-order thinking skills and appear to focus more on the science knowledge in the curriculum rather than on the nature of science or the social and environmental implications of chemistry.

Key Competencies:
While the program of study tends not to use the word competence, there are a number of generic skills that are promoted throughout the science and the chemistry curriculum program of study. These skills focus on scientific inquiry:

- initiating and planning
- performing and recording
- analyzing and interpreting
- communication and teamwork.

Secondary: Physics

In senior high school a variety of routes are available with several science and physics courses as shown in the chart above. This review covers the physics in both the physics and the science courses.

Coherence and Clarity:
The curriculum is complex in its presentation of interconnected aims and goals, and in the alternative senior high routes. Coherence is evident in the standard format of the documentation for each course. A major feature is the four foundations of attitudes, knowledge, skills and STS (the interrelations of science, technology and society). These are presented in considerable detail, but are common to all courses, that is, generic, for example, under knowledge:

> Physical science, which encompasses chemistry and physics, deals with matter, energy and forces. Matter has structure, and there are interactions among its components. Energy links matter to gravitational, electromagnetic and nuclear forces in the universe. Physical science also addresses the conservation laws of mass and energy, momentum and charge.

The description of the physics content to be covered follows generic material, which perhaps hampers clarity in appreciating the distinctiveness of each course program.

Scope:
Each of the junior high units has a common format of overview, focusing questions, key concepts and outcomes (under the headings of the four foundations). Each outcome statement is illustrated by an example. This makes the description of each unit long and detailed, but incorporates a lot of repetition between units. The Grade 7 unit Heat and Temperature (Social and Environmental Emphasis) has 18 statements in the Science, Technology and Society (STS) and Knowledge foundation section for example:

> Compare heat transmission in different materials (e.g., compare conduction of heat in different solids; compare the absorption of radiant heat by different surfaces).

There are two such units of physics for each of the three grades, which provide substantial scope, including light and optics, structures and forces, mechanical systems, electricity and space exploration.

The senior high curricula include much detail on ICT outcomes. The format for each course describes a wide range of attitude outcomes under four headings: Interest in Science, Mutual Respect, Scientific Enquiry, Collaboration, Stewardship and Safety. The course content is set out in similar format to junior high.

Science 10 has four units: physics is covered in both Energy in Technological Systems and Energy in Global Systems, both of which cut across science and technology to provide a

demanding and topically relevant introductory course for senior high school students. For example, the focusing questions for the Energy in Technological Systems are:

- which came first, science or technology, and is it possible for technological development to take place without help from pure science?
- how did efforts to improve the efficiency of heat engines result in the formulation of the first and second laws of thermodynamics?
- how can the analysis of moving objects help in the understanding of changes in kinetic energy, force and work?
- why are efficiency and sustainability important considerations in designing energy conversion technologies?

And for Energy in Global Systems*:*

- are there relationships between solar energy, global energy transfer processes, climate and biomes?
- what evidence suggests our climate may be changing more rapidly than living species can adapt?
- is human activity causing climate change?
- how can we reduce our impact on the biosphere and on global climate, while still meeting human needs?

The individual statements provide a wide range of approaches to answering these challenging questions, for example:

> Analyze and illustrate how the concept of energy developed from observation of heat and mechanical devices (e.g., the investigations of Rumford and Joule; the development of pre-contact First Nations and Inuit technologies based on an understanding of thermal energy and transfer).

Science 20 physics is in the one of the four units called Changes in Motion with two major outcomes:

- describe one-dimensional motion of objects in terms of displacement, time, velocity and acceleration
- describe and analyze the law of conservation of momentum for one-dimensional collisions and change in momentum (impulse) to explain how force affects motion.

These are then specified in considerable detail in relation to the four foundations, for example under STS (Science and Technology Emphasis):

> Explain that the goal of technology is to provide solutions to practical problems (for example, explain the need for safety technologies and regulations for transportation and sporting situations).

Science 30 has two of the four units with physics content – Electromagnetic Energy and Energy and the Environment which cover these areas in substantial detail.

Physics 20 four units are:

a) kinematics
b) dynamics
c) circular motion, work and energy
d) oscillatory motion and mechanical waves

each with general and specific outcomes, for example for Kinematics there is one general outcome, similar to Science 20:

> Students will describe motion in terms of displacement, velocity, acceleration and time.

This is then specified in detail under the foundation headings for example under STS (Nature of Science Emphasis): explain that the goal of science is knowledge about the natural world (for example, identify common applications of kinematics, such as determining the average speed of a run, bike ride or car trip, or the acceleration required to launch an aircraft from a carrier.

This illustrates the complexity of the curriculum with its three dimensions of physics knowledge foundation (STS) and emphasis (Nature of Science). It is possible to conclude that the scope is wide and the detail potentially confusing.

Physics 30 units are Momentum and Impulse, Forces and Fields, Electromagnetic and Radiation. This builds on Physics 20 and has a substantial mathematical flavor for example, under skills:

> Analyze data and apply mathematical and conceptual models to develop and assess possible solutions.

Demand and Progression:
The demands of these courses are substantial. The level of physics content is similar to many other jurisdictions, but the breadth of study that is required to address the four foundations and the three emphases, potentially increase this demand significantly, as illustrated by the examples detailed in the documents. The guidance makes it clear these are illustrations, not requirements, but they provide a clear measure of the level of demand expected.

Progression is clear in the documentation for Grade 7-9 through the common formats and the descriptions. Progression through the alternative routes in senior high is less clear. Specific references to prior study expected are provided in each course description, but, because of the

complexity of the different dimensions of the outcomes, it is difficult to be sure that progression would be unproblematic.

Assessment:
Grade 12 students sit diploma examinations in Science 30 or Physics30. The Science 30 examination multiple-choice items are context dependent, which provides a potentially wide range of responses. Numerical-response items are of several types, including: calculating numerical values; expressing ratios; selecting structures, functions, or statements from a diagram or a list; matching structures, functions, or statements from a diagram or a list; and determining the sequence of listed events, although in the physics questions these are mainly calculations. Science 30 examinations contain between 20 and 30% physics (with energy and the environment accounting for another 20-30%).

The Physics 30 diploma examination consists of 40 multiple choice and 10 numerical response questions and three written response questions. These machine scorable questions provide a good coverage of the syllabus at a range of difficulty, although there is a preponderance of recall and calculation answers. Several sets of questions are asked using a defined context, for example, the landing of a Mars probe, which enables a greater variety of responses to be given. The written response questions explore a physics problem in greater depth. The sample reviewed covered: using vectors, physics principles and experimental procedures. Very detailed scoring guides are provided with the sample questions showing marks awarded for quality of answer in several aspects, for example the diagrammatic and the mathematical handling of vectors. The standard of the examination is high, testing both the depth and the breadth of the curriculum. It does not, however, assess the attitudes and practical skills included in the learning outcomes, which are probably meant to be covered in school-based assessments and end of course certification.

Key Competencies:
It will be clear from the foregoing sections that there is considerable emphasis in the Alberta curriculum on a broad range of competencies. These include the four foundations used in presenting the learning outcomes and the three approaches, as well as a detailed description of attitudes and ICT competencies in the high school specifications.

Secondary: Social Studies

Orientation
The Alberta Social Studies Kindergarten to Grade 12 program of studies meets the needs and reflects the nature of 21st century learners. It has at its heart the concepts of citizenship and identity in the Canadian context. The program reflects multiple perspectives, including Aboriginal and Francophone, which contribute to Canada's evolving realities. It fosters the building of a society that is pluralistic, bilingual, multicultural, inclusive and democratic. The program emphasizes the importance of diversity and respect for differences as well as the need for social cohesion and the effective functioning of society. It promotes a sense of belonging and acceptance in students as they engage in active and responsible citizenship at the local,

community, provincial, national and global level (program of study Social Studies Grade 6 2005).

It is perhaps significant that under the role of social studies there comes a list of objectives in the somewhat unusual order of values and attitudes, knowledge and understanding and skills and processes.

A number of key strands / themes for the program are identified:

- time, continuity and change
- the land: places and people
- power, authority and decision making
- economics and resources
- global connections
- culture and community.

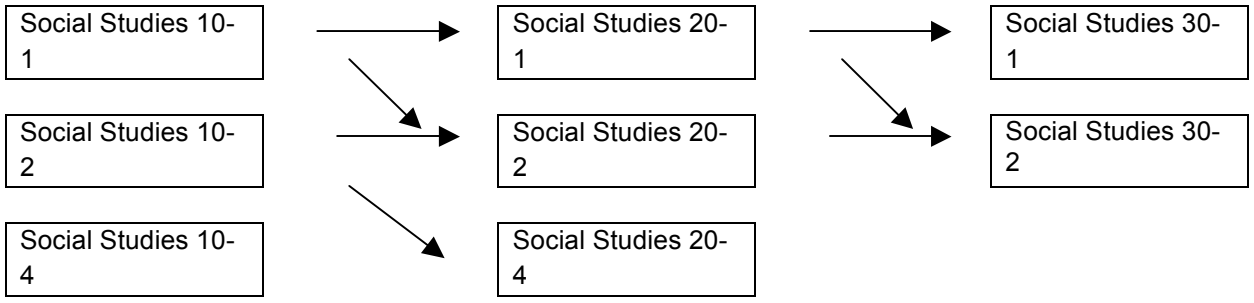
Coherence and Clarity
The table below summarizes the Alberta 7-12 social studies curriculum:

Grade 7	Canada: Origins, Histories and Movement of People 7.1 toward Confederation 7.2 following Confederation: Canadian expansions	A comprehensive examination of Canadian history preceding and flowing Confederation. The concept of intercultural contact is introduced through an examination of migration and immigration. The foundation for the continued dialogue on citizenship and identity in Canada
Grade 8	Historical Worldviews Examined 8.1 from isolation to adaption: Japan 8.2 origins of a western world view: renaissance Europe 8.3 worldviews in conflict: The Spanish and the Aztecs	Expansion of the concept of intercultural contact and continuation of development of historical thinking skills through an examination of past societies in different parts of the world.
Grade 9	Canada: Opportunities and Challenges 9.1 issues for Canadians: governance and rights 9.2 issues for Canadians: economic systems in Canada and the United States	Focus on citizenship, identity and quality of life and how they are impacted by political and legislative processes in Canada. The role of economic systems in Canada and the United States.
Senior High School Course Titles		*Linkages and Sequencing*
10-1 perspectives on globalization 10-2 living in a globalizing world		Grade 10 explores multiple perspectives on the origins of globalization and the local, national, and international impacts of globalization on identity,

	lands, cultures, economies, human rights and quality of life
20-1 perspectives on nationalism 20-2 understandings of Nationalism	Grade 11 explores the complexities of nationalism in Canadian and international contexts and includes study of the origins of nationalism and the influence of nationalism on regional, international and global relations.
30-1 perspectives on ideology 30-2 understandings of ideologies	Grade 12 explores the origins and complexities of ideologies. Students will investigate, analyze and evaluate government policies and actions and develop individual and collective responses to contemporary local, national and global issues

Assessment:
The 2010 social studies test is a multiple choice test focusing on knowledge/understanding and skills/processes (this reinforces the point made above about the lack of alignment with the intentions and goals of the program). Items are based on a variety of cartoons, text and graphics which themselves are quite undemanding for Grade 9 (where text is slightly more demanding key words (like 'recession') are defined for the examinee).

Progression:
As with other subjects, social studies courses are differentiated. Progression pathways are below.



Key competencies:
Competencies figure centrally in the social studies program, and these are understood as competencies subserving and enabling active, participatory and deliberative citizenship, a practice through which students are understood to be shaping and reshaping their social context.

Competencies identified by the program are understood under four headings:

- dimensions of thinking
- social participation as a democratic practice
- research for deliberative inquiry
- communication.

The focus of these skills is firmly democratic (rather than enterprise oriented). Teamwork is implied, but not stated.

> Students will develop interpersonal skills that focus on cooperation, conflict resolution, consensus building, collaborative decision making, the importance of responsibility and the acceptance of differences.

Secondary Social Studies: History

Orientation:
In Alberta history is understood as a subcomponent of a social studies program focused on developing glocal (global/local) citizenship. It is understood as a reflective and deliberative program through which students come to understandings of self and others in which agency is with the student. This formulation contrasts markedly with civics programs (such as the Massachusetts' social studies program) which conceive of students as passive assimilators of a pre-given heritage.

Values and attitudes, knowledge and understanding and skills and processes are foregrounded in the program and they appear in that order. History figures in the program in a present-centered way and as a tool to aid deliberative reasoning focused on continuing to achieve a pluralistic and multicultural society:

- understand the unique nature of Canada and its land, history, complexities and current issues
- understand how knowledge of the history of Alberta, of Canada and of the world, contributes to a better comprehension of contemporary realities.

History is understood not as content to be mastered so much as a process that students engage in, in order to achieve the kind of active and pluralistic citizenship that the program foregrounds. Accordingly, history is presented as "historical thinking" (something that students do and engage in) rather than as historical content. This historical thinking is explicitly identified as one of the dimensions of thinking developed by the program alongside creative, critical and deliberative thinking.[4] This emphasis on historical thinking as a tool for the development of deliberative and active citizenship is explicit:

> Understanding the dynamic relationships among time, continuity and change is a cornerstone of citizenship and identity. Considering multiple perspectives on history, and contemporary issues within their historical context, enables students to understand and appreciate the social, cultural and political dimensions of the past, make meaning of the present and make decisions for the future.

[4] The model of history presupposed here is very reminiscent of that developed in Barton, K. and Levstick, L. (2004) *Teaching History for the Common Good* (Lawrence Erlbaum Associates), a position that is widely influential but also controversial, particularly where disciplinary understandings of history are foregrounded (as, for example, in Lee's paper in Davies, I. (ed) (2011) *Debates in History Teaching* (Routledge)).

Coherence and Clarity:
As the social studies table, above, shows, the key accent in the program is on diversity and democracy. History figures explicitly as the focus of the program in many components of the K-Grade 8 program and is recessive thereafter, when what might be called political science comes to the fore. The comments below focus on Grade 6 onwards. It is worth noting, however, that the order of topics in K- Grade 5 appears coherent and progressive (moving outwards from understanding individual identities and family histories, through regional to national history – a pattern common in many of the curricula examined in this study).

The table below collates selected 'skills and processes… outcomes to be achieved' between Grades 6-12.

	Benchmark Skills and Processes Grades 6-12	
Grade	*Historical thinking*	*Critical / creative thinking*
6	use primary sources to interpret historical events and issues	assess significant local and current affairs from a variety of sources, with a focus on examining bias and distinguishing fact from opinion
7	analyze selected issues and problems from the past, placing people and events in a context of time and place	determine the validity of information based on context, bias, source, objectivity, evidence and/or reliability to broaden understanding of a topic or an issue
8	repeats Grade 7	repeats Grade 7
9	repeats Grade 7	repeats Grade 7
10	analyze multiple historical and contemporary perspectives within and across cultures	evaluate ideas and information from multiple sources
11	repeats Grade 10	repeats Grade 10
12	repeats Grade 10	repeats Grade 10

Although some attention has been given to cognitive progression across the grades in terms of headline objectives this is limited in at least three important respects:

- progression is expected to occur between Grades 6 and 7 and at Grade 10 but not in Grades 8 and 9 or after Grade 10
- progression across grades is poorly mapped – in some grades (for example Grade 6 and Grade 10 onwards) "historical thinking" is understood as involving epistemic understandings linked to the use and evaluation of source materials and multiple perspectives and in other grades (Grades 7-10) as involving contextualisation (one aspect of temporal understanding that tacitly references understandings of change/continuity). In other words, "Time, Continuity and Change" (the key strand of the curriculum explicitly linked to historical thinking') is explicitly operationalized as historical thinking in three of six grades only and then in a static way that assumes no progression

across those three grades – the curriculum is not conceptualized so as to achieve progression in the modes of understanding that it elsewhere claims to aim to develop
- there is overlap / poor differentiation of historical thinking and critical/creative thinking – the latter is understood epistemically in all grades and the former is understood epistemically in some grades; furthermore, it is not clear that progression is achieved across these objectives – it is hard to see any clear difference between the epistemic historical thinking objective for Grade 6 and the epistemic critical/creative thinking objective for Grades 10-12.

With the partial exception of one dimension of historical thinking, there is limited scope for coherent progression in historical understanding across grades. The one dimension where coherent progression has been modeled is contextualization / temporal understanding outcomes. Outcomes relating to this dimension of historical thinking are present in Grades 6 through to 10 and some progression is apparent (Grades 6 and 7 are identical, Grade 8 substitutes 'analyze' for 'explain', Grade 9 repeats Grade 8 but also adds an additional outcome and there is some reference to context in Grade 10).

Two examples of the limited way in which progression has been modeled follow:

- with the exception of an anomaly (the inclusion of 'to understand' in Grade 6 only) there is no scope for progression across Grades 6-9 in chronological sequencing outcomes
- progression is apparent between Grades 6 and 7 in historical evidence outcomes and between Grade 7 and Grade 12 but no consideration is given to this aspect of progression in Grades 8-11.

Highly detailed content-related objectives are identified for each grade. These are addressed below.

Scope:

As was noted above, historical content figures explicitly in some grades only. Comments in this section focus on those grades (Grades 6-8).

Grade	Historical Content	Exemplar 'questions and issues'
6	Historical models of democracy: Ancient Athens and the Iroquois confederacy	• how was the government of ancient Athens structured? • how did the social structure of ancient Athens impact its political structure? • to what extent were democratic ideals of equity and fairness part of the structure of government and society in ancient Athens?
7	Towards confederation and following confederation: Canadian expansions	Toward Confederation: • Who were the key figures in the French exploration and settlement of North America? • What roles did the Royal Government and the Catholic Church play in the social structure of New France (i.e., governor, intendant, Jesuits, religious congregations)? • Who were the key figures in the British exploration and

		settlement of North America? Following Confederation: Canadian Expansions: • What were the reasons for, and the consequences of, Newfoundland's joining Confederation? • How did joining Confederation impact the citizens of Newfoundland? • What are the social and economic effects of the changing roles and images of women in Canadian society (i.e., right to vote, working conditions, changing family structures)? • What challenges and opportunities have emerged as a result of increases in the Aboriginal population in western Canada?
8	From isolation to adaptation: Japan, origins of a western worldview: Renaissance Europe and worldviews in conflict: The Spanish and the Aztecs	From Isolation to Adaptation: Japan: • What were the motivations for the radical changes in Japan's model of organization during the Meiji period? • How did Japan adapt to changes brought on by the transition from feudal to modern models of organization? • How did the changes resulting from adaptation affect Japan economically, politically and socially during the Meiji period? Origins of a Western Worldview: Renaissance Europe: • How did the physical geography of Renaissance Europe affect trade and competition among European countries? • How did increased trade lead to the emergence of powerful city-states (i.e., Florence, Venice, Genoa)? • In what ways did thinkers and philosophers influence society in the development of a humanist worldview during the Renaissance? • In what ways were the Age of Discovery and the rise of imperialism expressions of an expansionist worldview? Worldviews in conflict: The Spanish and the Aztecs: • What were the key elements of the worldview of the Aztec civilization prior to contact with the Spanish? • How did the Aztec civilization's worldview influence the Aztecs' choices, decisions and customs? • What key elements of Spain's worldview led to the desire to expand the Spanish empire? • In what ways did factors such as technology and disease contribute to the dominance of the Spanish over the Aztec civilization? • To what extent were the divergent worldviews of the Spanish and Aztecs factors in the dominance of one nation over the other?

The curriculum seems somewhat imbalanced across the three grades analyzed in the table above (there is much more to cover in Grades 7 and 8 than in Grade 6).
The curriculum has breadth in the sense that:

- a range of issues (social, cultural, economic, political) are addressed
- more than one country is considered (Canada in Grades 6 and 7; Ancient Athens in Grade 6, Japan, Europe and Mexico in Grade 8).

On the other hand, the overwhelming impression is of limited curriculum content and one that may not develop students' big picture understandings of the history of the world. For example, it does not cover some regions – Africa, the Middle East, China.

It is difficult to pass judgment on depth without clearer insight into teaching and learning practices and resources. Some of the items in the table above suggest depth treatment of issues (for example, the items relating to the Aztecs) and others suggest a more superficial approach (for example, the notion that children should study the history of Athenian democracy by asking the question "To what extent were democratic ideals of equity and fairness part of the structure of government and society in ancient Athens?").

Overall, the historical content covered in the syllabus is focused through a "participative democracy" optic. This could possibly involve significant presentist and ahistorical thinking.

Assessment:
Sample assessment material was available for Grade 6. The assessment provided was entirely multiple choice. 45 questions are set and 18 of these questions are on historical content which represents 40% of the marks.

The table below analyzes questions against objectives:

	Iroquois Confederacy	Ancient Athens	Totals
Recall	3	2	5
Identify	3	1	4
Synthesize	2	1	3
Interpret		2	2
Evaluate		2	2
Conclude	1		1
Analyze		1	1

The questions cover the curriculum content objectives fully (there is a good match between the questions and the stated content of the curriculum). It is hard to see how the historical thinking objectives that the curriculum identifies can be addressed through multiple choice questions; it is doubtless reliant on teacher assessment. Two examples are examined below. There is some match between one question and its stated objective but no match between the second

question analyzed and its stated objective, suggesting that, on its own terms, the assessment does not completely fulfill its stated purpose.

Stated objective	Question	Comment
Synthesize information from a chart to recognize an advantage of a decision-making process	One advantage to using the decision-making process shown in the chart is that: a) each nation has its voice heard b) nations can resolve issues quickly c) decisions are announced to nations d) some nations have more power than other nations	To answer this question students have to comprehend a decision making flow chart and make a judgement (applying the concept 'advantage'). The task does require synthesis (of various statements in the flow chart). The application of a concept requires evaluation (not recognition as stated in the objective).
Information in the chart indicates that female citizens in Ancient Athens: a) were unable to work outside the home unless their husbands approved b) stayed at home and shared the duty of raising children with males c) stayed at home and were responsible for the household chores d) were unable to read and write, and therefore could not vote	Evaluate information in a chart to draw a conclusion about roles in ancient Athens	The correct answer is C. To answer this question a student would simply have to check components of the statements offered against content statements in the chart (in this case the relevant content statements are that women were 'were responsible for managing the household' and that they 'stayed at home and were taught housekeeping skills'). It is apparent that evaluation is not required to answer this question and that the question requires matching and combination only.

Primary/Secondary: Social Studies (Geography)

Orientation:

Geography is found within the social studies program of study. A prominent concern that runs through the document is Canada's (and Alberta's) pluralistic society, specifically referencing aboriginal heritage and francophone dimensions.

> [Social studies] is an issues focused …interdisciplinary subject that draws upon history, geography, ecology, economic, law, philosophy, political science, and other social science disciplines.

Coherence:
General outcomes statements are made for each grade level. These provide some sense of coherence. For example at Grade 7:

> Students will demonstrate an understanding and appreciation of the distinct roles of, and the relationships among, the Aboriginal, French and British peoples in forging the foundations of Canadian Confederation (one of three such statements).

This followed by a highly detailed list of specific outcomes, which read as a highly prescriptive list of recall statements (ironic in the context of the priority apparently given to values and attitudes in the objectives).

Scope:
The word geography does appear in the list on page 1 of the curriculum document (see above); it is not until page 9 that there is any real reference to the subject:

> Geographic thinking: Possessing geographic thinking skills provides students with the tools to address social studies issues from a geographic perspective. Geographic thinking skills involve the exploration of spatial orders, patterns and associations. They enable students to investigate environmental and societal issues using a range of geographic information. Developing these spatial skills helps students understand the relationships among people, events and the context of their physical environment, which will assist them to make choices and act wisely when confronted with questions affecting the land and water resources.

The K-12 summary under the heading scope and sequence, from a geographical perspective, describes a narrow curriculum. It is overwhelmingly historical in perspective driven by the explicit twin concepts of citizenship and identity. Environmental matters, processes and human relations with the natural world are barely featured at all, but they do feature prominently in the science curriculum (see above).

Levels of Demand:
It is unclear from the program of study how the laudable goals in terms of critical thinking, the soft skills development of "consensus building" and "deliberative enquiry" and so on are to be achieved through the highly specific content rich 'sequences'.

Furthermore the rationale for the content selections across the grade levels is not as clear as it might be. There is, understandably, a lot of Canada but even at the higher grade levels, where "living in a globalised world" comes in it is unconvincing that conceptually this program makes adequate demands on the students.

Progression:
On a superficial level it is possible to question whether the way the topics are specified might get in the way of progression in terms of increasing sophistication of critical skills.

Key competencies:
These are given detailed and strong prominence, although it is questionable whether many students see the softer skills identified, and notions such as critical thinking, developed as much as is maybe intended.

Vocational education

Orientation:
Technical vocational education and training (TVET) is taught to all students across Canada. The Learn Canada 2020 program has been established nationally, but each province has its own approach to TVET within that framework. Both Alberta and Ontario recognize the vocational/apprenticeship route as a means of accessing higher education.

The vocational system in Alberta has been built around occupational competencies within a credit framework, and has become bureaucratized. There is presently little parity of esteem between vocational and academic qualifications, with the Alberta High School Diploma being recommended as the preferred route for those able enough to access it.

However, the ministry has produced a new *Guide to Education* (Alberta Education 2013), which sets forth a new vision and regulatory structure:

> The education of our students is fundamental to shaping a preferred provincial, national and global future. It is also essential in maintaining Alberta's standard of living and ensuring our global competitiveness. Our education system must simultaneously prepare the citizens of tomorrow while equipping our students with the knowledge and skills they need to be successful in a rapidly changing economy and society.

The responsibility for quality is placed firmly with schools:

> Schools have the responsibility to provide instructional programs that ensure students will meet the provincial high school completion requirements and are prepared for entry into the workplace or post secondary studies. As well, schools are to ensure that students understand the rights and responsibilities of citizenship and have the skills and attitudes to pursue learning throughout their lives.

The *Guide* includes a summary of recent ministerial orders, some of which are highly aspirational. It elaborates on the underlying goal that all students acquire an entrepreneurial spirit, which good TVET complements.

> Whereas an individual with an entrepreneurial spirit is motivated, resourceful, self-reliant and tenacious; continuously sets goals and works with perseverance and discipline to achieve them; through hard work, earns achievements and the respect of others; strives for excellence and personal, family and community success; is competitive and ready to challenge the status quo; explores ideas and technologies alone or as part of diverse teams; is resilient, adaptable, able and determined to transform discoveries into products or services that benefit the community and, by extension, the world; develops opportunities where others only see adversity; has the confidence to take risks and make bold decisions in the face of adversity, recognizing that to hold back is to be held back; and has the courage to dream.

Coherence and Clarity:
In senior high school vocational education is built around two programs, Career and Life Management (CALM) and Career and Technology Studies (CTS). These are intended to help students to make well-informed choices in all aspects of their lives. At present CALM focuses much more on health than on career issues and is described in the Alberta Learning Mission statement, Business Plan 2002–2005 as:

> ....the core course for health literacy at the senior high school level in Alberta. CALM furthers the Alberta Learning Mission. In CALM, students continue to work toward becoming "responsible, caring, creative, self-reliant and contributing members of a knowledge-based and prosperous society.

CALM courses are locally constructed by schools around a set of requirements. CTS is much more specifically related to the national qualifications framework definition of occupational skills.

Graduation from high school requires three credits in CALM, the same as for PE, which may be taken in Grade 10, 11 or 12, plus 10 credits in any combination from: career and technology studies, fine arts, second languages, physical education, knowledge and employability courses, a recognized apprenticeship, or locally developed provision in CTS, fine arts, second languages or knowledge and employability occupational courses.

CTS is aligned to the National Occupational Classification Framework. This is classified in exhaustive detail through statements of competence. The CTS program provides learning opportunities for students to:

- develop skills that can be applied in their daily lives, now and in the future
- refine career-planning skills

- develop technology-related skills
- enhance employability skills
- apply and reinforce learning developed in other subject areas
- prepare for transition into adult roles in the family, community, workplace and/or further education.

It is aligned to levels rather than grades, is competency based and recognizes prior learning from both formal schooling and personal initiatives.

Scope:
CTS from Grade 11 is competency based, designed around proposed career pathways. It is constructed around five clusters:

- business, administration, finance and information technology
- health, recreation and human services
- media, design and communication arts
- natural resources and trades
- manufacturing and transportation.

Each has defined sub-sets, for example, the sub set of Art/Design and Communication is further divided in to practical arts, ceramics, graphic arts, photography and audio/video. The emphasis is strongly on partnership with industry, but with an emphasis on the craft skill level. For example formal agreements have been established with the automotive, service technician, carpenter, cook, hairstylist and welder trades.

However, those designing the curriculum are tasked to enhance academic competencies through each area of study, emphasizing literacy, numeracy and technology, and to emphasis the soft skills, which are described in great detail. The following are examples only from a daunting list:

- work skills
- organizational skills
- workplace performance
- positive workplace attitude
- career awareness
- applied academic skills
- safety
- knowledge (concepts and skills)
- demonstrate effective oral and written communication skills
- demonstrate an understanding of basic occupational terminology
- use appropriate nonverbal communication skills
- listen effectively

- add, subtract, multiply and divide, using fractions, decimals and whole numbers, and apply basic computations to complete a task
- identify metric and imperial units of measurement
- count and make change for money up to $100
- estimate the supplies, materials and equipment required for a task
- enhance literacy and numeracy skills through basic computer operations
- plan and prepare effectively to ensure the completion of tasks or activities
- demonstrate critical thinking before making decisions
- follow instructions to complete all tasks
- clarify task requirements to ensure completion
- demonstrate dependability by arriving on time and completing tasks on schedule
- demonstrate perseverance to ensure task completion.

These requirements become more complex according to the level of study.

Levels of Demand:
CTS courses are primarily locally designed against the qualifications framework criteria, and enable schools to design courses that meet the needs of students and take advantage of community resources. They are competency based and set against occupational levels. Knowledge and employability courses are less skills-specific and develop employability within occupational contexts. The courses provide students opportunities to continue their education or enter employment.

The requirement for art/design, Grades 8/9 specifies firstly collaboration skills:

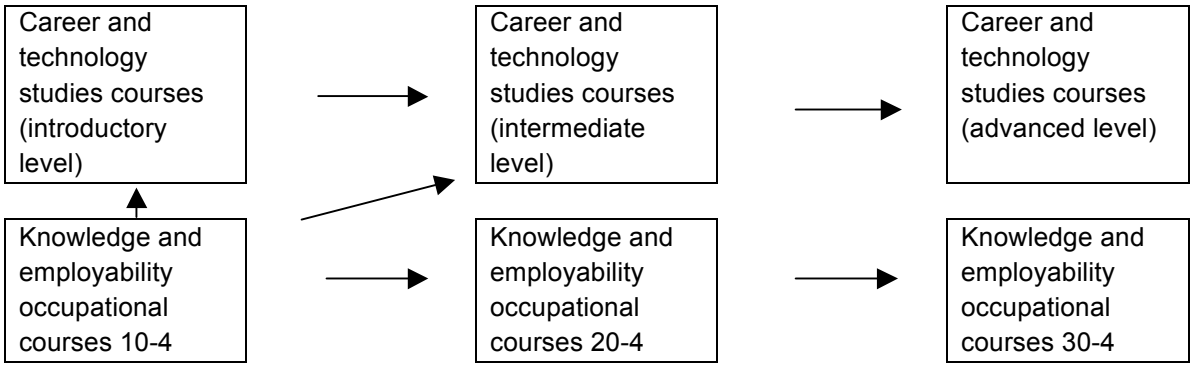
- demonstrate cooperation, selflessness and concern for others while working as members of a team
- demonstrate responsibility by meeting deadlines and completing tasks
- demonstrate enthusiasm and a willingness to try when attempting a task
- demonstrate their commitment to improvement by accepting advice and constructive criticism
- demonstrate a regard for the environment by following proper procedures for the clean-up and disposal of materials.

Then skill specific outcomes:

- understand the elements of design
- understand basic binding and finishing operations; e.g., fold, cut and / or collate pages; emboss, laminate and drill holes in pages
- understand the use of computer programs to design and print various print media
- identify the five basic printing methods; i.e., relief, gravure (intaglio), lithography, screen printing and electrostatic etc, together with the academic skills as described for CTS.

The National Occupational Qualification Classification Framework (NOC) has descriptions at introductory, intermediate and advanced levels. The core statement becomes more stretched through the levels. For example, trades, manufacturing and transportation courses, specifies Cabinetmaking – Web and Face Frame at introductory, which becomes Doors, Windows and Siding at intermediate, and Doors and Trim at advanced level.

Progression:
The progression pathways from knowledge and employability occupational courses to career and technology studies (CTS) courses are below. Each CTS course carries one credit; each knowledge and employability course carries five credits.



Vocational qualifications from upper secondary onwards are categorized as certificates, diplomas, apprenticeships, applied degrees and, in some cases, undergraduate degrees. The CTS program provides certificates for high school leavers, who may choose to continue their education, or to seek employment. There are potentially 1000+ one-credit courses in 28 occupational areas within the NOC. Students may receive the Certificate of School Completion, Certificate of Achievement or Certificate of High School Achievement depending on the courses they have taken and credits they have amassed.

The Knowledge and Employability (KE) cluster of courses is less skills specific, and develops learning through broader occupational contexts. Students taking KE courses may qualify for a Certificate of High School Achievement or they may continue their studies to qualify for an Alberta High School Diploma.

In the most recent publication (Alberta Education 2013b) parents are cautioned about certificate level vocational courses, and advised to seek academic diploma studies where possible.

> Enrollment in the Certificate of High School Achievement should only be considered after full consultation with the student's parents or guardians. If there is no agreement by parents for their child to participate in Knowledge and Employability courses, all efforts will be made to ensure that the student is on the path to achieve the Alberta High School Diploma. While enrolled in Knowledge and Employability courses, every effort should be made to successfully transition students from Knowledge and Employability courses to other high school courses

> that support the attainment of an Alberta High School Diploma. In addition, students may have access to other courses to successfully transition into continuing education and other training opportunities (e.g., appropriate college courses and/or apprenticeship programs).

For students opting for the high school diploma parents are advised that this may lead to an apprenticeship program, but it is intended more as progression to further and higher education.

Assessment:
Assessment is locally based and for vocational certificates it is against the published criteria of the National Occupational Classification Framework. Teachers are advised that:

> Ongoing assessment of student progress informs the student, parents and teacher of what has been achieved and of what is yet to be achieved. Learning and instruction should be consistent with student abilities and should set appropriate levels of challenge.

Key competencies:
Key competencies such as problem solving, teamwork, self-learning, creativity, critical thinking competencies are intrinsic parts of the requirements for a certificate and are part of the criteria for many of the vocational courses.

Province of Ontario

History and background

Ontario is Canada's largest province, with a population of over 13 million and a public education system that educates about two million students in 5,000 schools. Its teaching force is approximately 120,000 strong. Ontario educates 40% of all Canadian students and has a diverse population in terms of ethnic and religious background, particularly through recent immigration.

As in other Canadian provinces, the Ministry of Education (MOE) has jurisdiction over financing education, setting standards, defining curricula, supervising and inspecting schools. Ontario schools are run through district school boards and school authorities. Publicly-funded education in Ontario consists of four types of school boards or districts: 31 English language public (state); 29 English language Catholic; four French language public and eight French language Catholic. There are 11 school authorities that are comprised of four regional boards, six hospital based boards and the Provincial Schools Authority. Teacher training and education takes place exclusively at universities but standards for certification have been set by the Ontario College of Teachers, a self-governing body, since 1996 (Ontario MOE 2014b).

Although commentators consider that the education reform movements in Canada have been consensual, the changes in Ontario have been politically contentious. The Conservative government introduced sweeping education reform in 1995, including a more standardized (and limited) curriculum, a reduction in the number of years in senior high school from five to four, the tracking of students starting in Grade 9 and continuing through high school, increased graduation requirements, the reduction of three high school streams to two for Grades 9 and 10 (then four in Grades 11 and 12 aligned to destination), standardized report cards and the introduction of literacy test requirements in order for students to graduate from high school. Accompanying these reforms, the government developed a set of policies that featured centralized testing and strong teacher accountability. These reforms met with considerable opposition from the province's teachers and were bitterly opposed when phased in from 1999, with some believing they left an ongoing legacy of ill will between Ontario's teachers and the MOE (Winton 2012, Pinto 2012).

The subsequent Liberal provincial government, elected in 2003, developed a different approach based on engagement and collaboration with and between teachers and schools. However, the newly-elected government left most of its predecessor's reforms in place, with only some modifications or additions.

The 2003 reforms concentrated on improvements in three areas, literacy, numeracy and decreasing the high school dropout rate, the last under the auspices of the "Student Success Initiative/Learning to 18," commonly referred to as SSI. SSI included (but was not limited to) the development of a new high school program for students with the intent of helping those labeled

"at risk", the Specialist High Skills Major (SHSM). Schools construct an SHSM by bundling existing courses and field placements (known as co-ops) around a professional theme (for example, arts and culture, food services, entrepreneurship, etc.) and the MOE approves the structure and requirements. Those who complete an SHSM receive a "Red Seal" on their high school diploma to indicate achievement. Participation grew from 600 students in 2006 (the launch), to 42000 in 2013. While the program was initially established for those students at risk (and tracked in non-university pathways), by 2013 SHSM participant composition was only 4 to 5% of students tracked in workplace provision, and over half were tracked in the "university" pathway (Levin 2008, Fuller 2010).

Over the past eight years Ontario has seen a steady improvement in student outcomes as well as improved teacher morale and support from parents. The government claims that notable features of this period include a sustained attention to a small number of goals, strong political leadership, respect for the professionalism of teachers and educationalists and a focus on building capacity.

PISA results detailing the differences between those born in Canada and those who were not suggest that Canada in general, and Ontario specifically, has done well with its immigrant population. About a quarter of students were born outside Canada, 80% of whom arrived without speaking English. Part of the 2004 reforms were targeted developments aimed at immigrant children and schools are now charged with incorporating immigrant children into the mainstream culture as quickly as possible (OECD 2010). However, critics suggest that improvements are a result of "teaching to the test" rather than due to any equity-oriented policy or reforms. There have been several key initiatives for improving ESL education led by the MOE. In 2005 the Auditor General's offered criticism about a lack of resources for schools' ESL program offering and a lack of assessment and tracking tool for English language learners, which led to a province-wide initiative to develop a new assessment framework to be used by teachers with students.

In the same year, the MOE established a schedule for ongoing curriculum review titled "sustaining quality curriculum." The review is not a one-off program but a rolling program with a number of subject areas reviewed each year. The goal is to keep subjects current, relevant and age-appropriate. The reviews are research-based, benchmarked against other jurisdictions and involve subject experts, higher education, parents, students and other ministries (Ontario MOE 2013a).

Structure of educational system

The Ontario school system is organized with two years of early childhood education (ages four and five), eight years of elementary (ages six to 13), and four years of secondary (ages 14 to 17). Students graduating from secondary obtain the Ontario Secondary School Diploma (OSSD), which allows them to pursue three paths of further education: apprenticeships, community college or university.

The MOE makes regulations governing the school year and school holidays and school boards are required to prepare, adopt and submit calendars for approval. School year calendars must normally be completed in accordance with the Education Act and must include a minimum of 194 school days. These must include at least 190 instructional days; the additional four days are usually designated as professional activity (in-service training) days. The school year usually begins on or after 1 September and ends on or before 30 June. Typical school days in Ontario run from 9:00 am to 3:30 pm, although many schools offer integrated day care which extends the day from 8:00 am to 6:00 pm.

Types of schooling, ages of transition

In 2010-11 Ontario introduced a program for free full-day kindergarten for four- and five-year old children. A number of local school boards have incorporated this level into their elementary schools.

Elementary schools typically provide education for all grades between Kindergarten and grade 7 or 8. Secondary schools run grades 8/9 to Grade12, although some secondary schools start at Grade 7. Overall, children from age six are obligated to attend schools until age 18 or until they graduate from high school.

Transition through Grades 1 to 8 depends on successful achievement of curricular standards for each grade. While there is no ministry policy on grade promotion, at the elementary level, decisions related to promotion are made by school principals in consultation with the students' teachers and parents.

Although the decision is left up to the schools, very few children in Ontario repeat grades. Very few districts even keep numbers on grade retention in elementary school. Section 265.1g of the Ontario Education Act (Government of Ontario 1990) states that "subject to revision by the appropriate supervisory officer," it is the duty of principals to "promote students." *The Ontario Student Record Guideline* (MOE 2000) tells teachers to make sure that parents are consulted well before reporting time and that everything is being done to help students who are at risk of failing. That way the proper interventions are put in place early enough to prevent failure (Michaelis 2010).

Once students reach Grade 9 there are three types of courses offered, each of which runs through Grades 9 and 10:

Academic courses develop students' knowledge and skills through the study of theory and abstract problems. These courses focus on the essential concepts of a subject and explore related concepts as well. They incorporate practical applications as appropriate.

Applied courses focus on the essential concepts of a subject and develop students' knowledge and skills through practical applications and concrete examples. Familiar situations are used to

illustrate ideas, and students are given more opportunities to experience hands-on applications of the concepts and theories they study.

Open courses, which comprise a set of expectations that are appropriate for all students, are designed to broaden students' knowledge and skills in subjects that reflect their interests and prepare them for active and rewarding participation in society. They are not designed with the specific requirements of university, college, or the workplace in mind.

Students in Grades 9 and 10 can select an appropriate combination of courses from each of the three pathways. Students are not expected to make binding decisions about a particular educational or career pathway at this stage. School boards must offer both academic and applied courses in English, mathematics, science, history, geography, and French as a second language.

There are a further five pathways open for students to follow in Grades 11 and 12:

College preparation courses are designed to equip students with the knowledge and skills they need to meet the entrance requirements for most college programs or for admission to specific apprenticeship or other training programs.

University preparation courses are designed to equip students with the knowledge and skills they need to meet the entrance requirements for university programs.

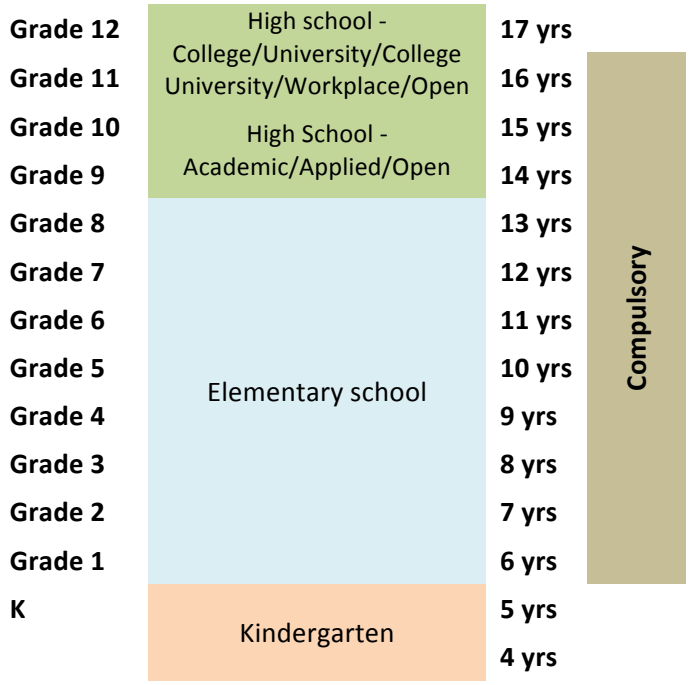
University/college preparation courses are designed to equip students with the knowledge and skills they need to meet the entrance requirements for specific programs offered at universities and colleges.

Workplace preparation courses are designed to equip students with the knowledge and skills they need to meet the expectations of employers, if they plan to enter the workforce directly after graduation, or the requirements for admission to certain apprenticeship or other training programs.

Open courses, which comprise a set of expectations that are appropriate for all students, are designed to broaden students' knowledge and skills in subjects that reflect their interests and prepare them for active and rewarding participation in society. They are not designed with the specific requirements of university, college, or the workplace in mind.

In Grades 11 and 12, students will focus increasingly on their individual interests and will identify and prepare for their postsecondary pathways. School boards are required to ensure that students in Grades 11 and 12 have access to an appropriate destination-related course in at least English, mathematics, and science, in accordance with the course types included in the curriculum policy (Ontario MoE, 2011)

The chart below shows the type of schooling available and the ages of transition from one type to the next:



Policy aims and vision

Ontario's education vision is based on the belief that its students must benefit from one of the best public education systems worldwide, with high levels of student achievement and engagement. Education must provide all students with the "skills, knowledge and opportunities to reach their full potential, to pursue lifelong learning and to contribute to a prosperous, cohesive society" (MOE 2014a). Ontario aims for all students to leave secondary school with a clear plan for their initial post-secondary destination, apprenticeship, college, community living, university and/or workplace.

In 2014 Ontario updated its vision of student success to emphasize higher order thinking skills such as critical thinking, communication, creativity, collaboration and entrepreneurship. There is to be a renewed emphasis on student well-being in order to create healthy, resilient and well-rounded young people.

Ontario's education goals, articulated in *Achieving Excellence: A Renewed Vision for Education in Ontario* (MOE 2014a) are*:*

- achieving excellence: children and students of all ages will achieve high levels of academic performance, acquire valuable skills and demonstrate good citizenship
- educators will be supported in learning continuously and will be recognized as among the best in the world
- ensuring equity: all children and students will be inspired to reach their full potential, with access to rich learning experiences that begin at birth and continue into adulthood
- promoting well-being: all children and students will develop enhanced mental and physical health, a positive sense of self and belonging, and the skills to make positive choices
- enhancing public confidence: Ontarians will continue to have confidence in a publicly funded education system that helps develop new generations of confident, capable and caring citizens.

The guiding beliefs and principles of Ontario education relate to "student success" and the "importance of comprehensive education."

Student success is based on three core beliefs:

- all students can be successful
- success comes in many forms
- there are many pathways to success.

A comprehensive education is one that:

- is knowledge- and skills-based
- inquiry-based
- developmentally appropriate
- holistic
- transformational
- inclusive
- differentiated.

21st Century Skills

Ontario's 21st century skills strategy has been combined with the government strategy for literacy and numeracy. In this way there is a serious attempt to embed these skills and competencies within the curriculum. This is further evidenced by an emphasis on cross-curricular competencies and the inter-relationships between disciplines.

The MOE sets out the following undertakings to respond to 21st century challenges:

- engaging students as partners in their own learning

- harnessing the capacity of technology to engage learners and to optimize and amplify student learning and achievement
- emphasizing and teaching important higher-order skills such as critical thinking, communication, collaboration, creativity and entrepreneurship
- supporting educators in preparing our students for a rapidly changing, technology-driven, globalized world.

A ministry resources for educators website, EduGains (EduGains 2014) states that Ontario school districts are engaged in collaborative research and sharing what they are learning about effective technology-enabled 21st century practice for student learning and success. The ministry announced a comprehensive program for innovation. They launched two "21st century pilots for system learning" and in 2012-13 72 district school boards began participating, with a strategic focus on:

- assessment practices
- bring your own device
- cloud-based learning environment
- differentiated instruction
- learning commons and e-readers
- special educational needs
- leadership.

21st century skills have been an important focus of reforms of the system and have been combined with government strategy for literacy and numeracy in a coordinated way. In its policy paper entitled *Reach Every Student – Energizing Ontario Education* (MOE 2008b) the government announced its intention to go 'deeper and wider' on literacy and numeracy and get 75% of students to an advanced level on these skills. It defined advanced literacy for the 21st century as follows:

> Literacy is defined as the ability to use language and images in rich and varied forms to read, write, listen, view, represent, and *think critically* about ideas. It involves the capacity to *access, manage, and evaluate information*; to think imaginatively and analytically; and to communicate thoughts and ideas effectively (emphasis ours).

What is interesting is the emphasis placed not only on the relationship between literacy and critical, creative and analytical thinking for communicating but also its relationship to equity and good citizenship. The policy paper continues with its definition as follows:

> Literacy includes *critical thinking* and reasoning to *solve problems* and *make-decisions* related to issues of fairness, equity and social justice. Literacy connects individuals and communities and is an essential tool for personal growth and active participation in a cohesive, democratic society (emphasis ours).

The government's definition of advanced numeracy is equally focused on higher order thinking

and application, “through mathematical activities that are practical and relevant to their lives, students develop mathematical understanding, problem-solving skills, and related technological skills they can apply in their daily lives and in the future workplace” (MOE 2008).

This emphasis on critical thinking is not limited to language arts, mathematics, and science, but permeates all subjects in the Ontario curriculum, as does the development of *metacognitive skills* (thinking about thinking). It is also woven into the fabric of everyday life in Ontario’s schools. It can be seen in the curriculum documents that frame the goals of education in the province, the professional development supports offered to teachers, the structure and diversity of program offerings for students in the high schools, and in the language the government uses in its publications to communicate with Ontario parents and citizens.

In Ontario, advanced literacy and numeracy skills are framed as a means to enable students to solve real-world problems. This focus on application of knowledge and skills is accompanied by a very strong commitment to an individualized, customized approach to education. One example of this is the Specialist High Skills Majors (SHSM) program that offers high school juniors and seniors an opportunity to customize their educational program by aligning their academic courses with an occupational area they want to explore. There are 18 majors, covering a broad range of occupational sectors, e.g., arts, construction, energy, environment, ICT and sports (OECD, 2012). This shows a preoccupation to link schooling with the world of work and the program provides the opportunity for work shadowing and internships.

The strategy of Ontario education shows a joining up of teaching, learning and assessment and of a cross-curricular emphasis. The Teacher-Learning Critical Pathway (T-LCP) model is a good example of this. This is a process of promoting teacher learning as well as student learning by focusing discussion and action on examining “the interdependence of curriculum expectations, assessment of and for learning, thinking strategies, teaching strategies, and reflection” (Hine and Maika 2008, in OECD 2012).

Information technology in schools and the curriculum

The MOE sets out the following goals for students for technological education:

> Gain an understanding of the fundamental concepts underlying technological education; achieve the level of technological competence they will need in order to succeed in their postsecondary education or training programs or in the workplace; develop a creative and flexible approach to problem solving that will help them address challenges in various areas throughout their lives; develop the skills, including critical thinking skills, and the knowledge of strategies required to do research, conduct inquiries, and communicate findings accurately, ethically, and effectively; develop lifelong learning habits that will help them adapt to technological advances in the changing workplace and world; make connections that will help them take advantage of potential postsecondary educational and work opportunities (MOE 2009).

One interesting initiative is the BYOD (Bring your own device) (referred to above as part of the pilot scheme launched in 2012-13) which several school board districts are operating. In Ontario the aim of BYOD is to increase access to digital technology in schools. Nevertheless the report points to reports from principals referring to challenges with regard to outdated technology lack of network infrastructure, and slow or unstable wireless access (Chen et al, 2014).

Innovation in education

The OECD's *Measuring Innovation in Education* (OECD 2014a) offers a way of measuring educational innovation using outcomes from TIMSS, PIRLS and PISA. It should be noted that using these data means that any innovations identified will tend to be only in the subjects or age sectors tested in these studies.

The OECD ranked Ontario as 13th most innovative system of the 29 jurisdictions covered. Its report suggests the following as Ontario's five most significant organizational innovations between 2003 and 2011:

- *more external evaluation of primary and secondary school classrooms*
  Primary and secondary schools in Ontario underwent frequent observations of teachers' practices by inspectors or other people external to the school. Between 2003 and 2011, Ontario saw a 16% point increase in the percentage of Grade 4 students in schools in which observations by external evaluators were used to evaluate the practices of their teachers. Over the same period, Grade 8 science students saw a 12% point increase and Grade 8 mathematics students a 15% increase in external evaluation.
- *more teacher observations of secondary school classrooms*
  Ontario's teachers also frequently observed each other's classrooms to learn about their peers' teaching practice. Between 2003 and 2011 the percentage of Grade 8 mathematics students who had a teacher who observed other classrooms at least once a week increased by 9% points from the last survey, while for Grade 8 science students the increase was 10%.
- *more peer discussions amongst secondary science teachers*
  Between 2003 and 2011, the level of peer to peer discussion among Grade 8 science teachers to exchange pedagogic ideas increased by 12% points. Of the educational systems analyzed in this report, Ontario saw the second largest change in this metric; Israel, the system with the largest change, had a system level increase of 34% points over this period.
- *more peer evaluation of teachers in primary education*
  Teachers in Grade 4 classrooms saw an increase of 8% points in the percentage of students in schools with peer review evaluations, a little over the OECD average of 6%.
- *more teacher collaboration to develop secondary science materials*
  Change in collaboration in planning and preparation of instructional materials is another indicator of innovation in instructional collaboration. Between 2003 and 2011, the

percentage of Grade 8 science students in Ontario who had teacher who collaborated with other teachers in planning and preparing instructional materials increased from 33% to 38%, slightly above the 2011 OECD mean value of 35%.

In terms of pedagogic innovation the OECD reports suggests that Ontario's main innovations are:

- *more relating of lessons to real life in primary and secondary lessons*
  Ontario' top pedagogic innovation is the practice of relating content in lessons to students' daily life. Between 2003 and 2011, Ontario saw a 27% point difference in the percentage of students whose teachers ask them to relate what they learn in class to their daily life in at least half of their lessons. Ontario also experienced large gains in the percentage of 4th grade students whose teachers ask them to relate what they read with their own experience in at least half their lessons, with an 18% point gain in this metric from 2001 to 2011.
- *more observation and description in secondary school science lessons*
  Ontario's students are increasingly asked to explain and elaborate upon their answers during school science lessons, something that the OECD claims increased students' curiosity and scientific communication skills. There was a 26% point increase in Grade 8 students being asked to observe and describe natural phenomena during science lessons.
- *more self-direction in complex decision making in secondary mathematics*
  Innovation in the classroom has also resulted in a change in the use of student self directed work during lessons in secondary education. Between 2001 and 2011, the percentage of 8th grade students whose teachers ask them to decide on their own procedures for solving complex problems in mathematics lessons increased by 26% points (according to teachers). This change was the highest of any educational system included in this analysis and was 21% points higher than the average change for OECD countries.
- *more self-directed experiments in primary science lessons*
  Between 2001 and 2011, the percentage of primary science students whose teachers ask them to design or plan experiments or investigations at least once a month increased by18% points according to teachers. This change was higher than the mean OECD country change (a 9% point increase) and the fifth largest change of all countries analyzed in this report.
- *more text interpretation in primary lessons*
  The extent to which students interpret text in Grade 4 reading lessons has risen in Ontario. Between 2001 and 2011, the percentage of students whose teachers ask them to make generalizations and draw inferences from a text one or more times per week increased from 80% to 94%, a 14% point gain. While this increase is significant, it is below the mean difference in this metric for OECD countries, which was 16% points over the same period.

Governance

School education in the province of Ontario is governed by the minister of education, an elected member of the provincial legislature appointed by the premier of the province. There is a separate Ministry of Training, Colleges and Universities in charge of vocational and higher education. Locally-elected school boards, representing language and religious diversity of the province (English, French, Catholic and non-Catholic boards) are in charge of the administration of the approximately 4,800 schools serving over two million students in the province (Ontario MOE 2014b). The Ministry of Education is in charge of the necessary arrangements for funding elementary and secondary schools, and designing major policies in key areas such as curriculum and assessment, the teaching profession and accountability[5].

Historically, local school boards (now more usually termed "districts") were responsible for determining their community's educational facilities, services and other resources, as well as for raising the money through local taxes to pay for these resources. School districts' authority to levy taxes was removed in1998 and districts now receive funding from the province through funding formulas. School boards are elected locally and are responsible for allocating their resources to support provincial priorities – raising student achievement, closing the achievement gap between students and enhancing public confidence in education. The school districts are also in charge of appointing staff, hiring principals and senior administrators and managing the budget allocated to schools.

Regulations that formalize the school boards' responsibilities for student achievement; setting out the roles and duties of school boards, directors of education, individual trustees, and school board chairs; clarifying the role of Parent Involvement Committees; and addressing trustee codes of conduct and enforcement are contained in the 2009 Education Act, Bill 177, *Student Achievement and School Board Governance Act* (Sattler 2012).

Prior to 1996, provincial reviews of student achievement were conducted using random samples of students. After the recommendations of the Royal Commission on Learning (1994), the Education Quality and Accountability Office (EQAO) was established and initiated a process to implement assessments in literacy and mathematics for all students, the main focus of which was to monitor students' achievements at key junctures. Provincial testing was also positioned politically as a way to assure the public that all students were being assessed in an identical way and to an established set of standards (the Ontario curriculum). The information gathered by the EQAO is intended to provide the necessary independent and public scrutiny of the education system in the province, assuring transparency and accountability, however this claim is contested, with critics such as Pinto charging that there is political manipulation of criteria to fulfil political needs (Pinto, 2012).

[5] For further details, see http://www.edu.gov.on.ca/eng/funding/1314/Technical13_14.pdf

The EQAO administers the standardized testing system in Ontario, which includes literacy and numeracy testing for Grades 3 and 6, as well as a Grade 9 mathematics test and the Ontario Secondary School Literacy Test (OSSLT) administered in Grade 10 based on Grade 9 outcomes, which is a condition for high school graduation.

Ontario's teacher performance appraisal is structured by the MOE, but administered by school administrators (principals and vice principals). Teachers are rated on 16 competencies aligned to Ontario College of Teachers' standards of practice: professional knowledge, professional practice and leadership in learning communities and on-going professional learning. In all but the direst cases, the outcomes are couched in recommendations for professional growth goals and teacher development strategies. This may be considered a non-judgemental system, as opposed to using performance related pay or judging teachers solely on their test results (Fullan 2012).

Local school boards are responsible for improving student achievement. For this purpose, they use EQAO data from the standardized testing system. The results from EQAO tests also are used by local school boards to monitor and assess school and student performance (see 'Student Achievement and Board Governance Act' (2009)), and by the MOE to identify and target areas, schools and school boards where support and resources are most needed (special programs, teacher professional development or specialist support for students). The results also are used to evaluate the impact and effectiveness of province initiatives to improve student achievement.

The EQAO tests are based on the Ontario Curricular standards and are applied in the following grades:

- Grade 3: literacy and mathematics (the end of the primary division of elementary school)
- Grade 6: literacy and mathematics (the end of the junior division of elementary school)
- Grade 9: mathematics (the beginning of high school)
- Grade 10: literacy is tested as part of the requirements for the Ontario Secondary School Diploma (OSSD). This is the only test that has a direct influence on students' outcomes.

Results are reported to the students, schools and school districts indicating their achievement and areas of improvement. Special conditions are considered for SEN and ESL students.

According to EQAO publications, there is widespread public support (including educator support) for provincial testing (EQAO 2012; EQAO 2013). However, results and their use are sometimes met with skepticism, and early controversies occurred over the introduction of the tests, which included legal challenges that resulted in the establishment of a tribunal within EQAO to settle such disputes (Pinto 2012).

Public/private

There are more than 900 private (independent) schools in Ontario serving over 100,000 of Ontario's two million students. All independent schools are registered with the MOE, but the ministry does not regulate, license or accredit private schools. Private schools operate either as businesses or as non-profit making organizations. They are required to follow the legal requirements of the *Education Act*, but receive no governmental funding. Principals and teachers in private schools are not required to be certificated by the Ontario College of Teachers. Some, but not all, private schools follow the Ontario curriculum. If a private school is authorized to award an Ontario secondary school diploma, then it is subject to inspection by the ministry.

Ministry policy requires that a private school must have the following:

- a principal in charge of the school
- control of quality of instruction and evaluation of student achievement
- control of content of the program or courses of study
- a common school-wide assessment and evaluation policy
- a common procedure for reporting to parents
- a common school-wide attendance policy
- a central office for the maintenance of student records (Ontario MOE 2013b).

Textbooks

The Trillium List contains the titles of those textbooks approved by the Minister of Education for use in Ontario schools that have undergone a regulated evaluation process as spelled out in the *Guidelines for Approval of Textbooks* (MOE 2008a). Individual school boards are responsible for selecting textbooks from the list and approving them for use in their schools. The boards have sole responsibility for the selection and evaluation of supplementary resources.

Textbooks must be congruent with Ontario's curriculum policy, have a Canadian orientation and support a broad range of instructional strategies and learning styles. Activities in the textbooks must provide students with opportunities to engage in higher-order thinking and problem solving and provide a range of tasks – open-ended, teacher directed and tasks for students to do independently. Textbooks should include ways of helping students make connections within and between the strands of the subject or course and, if appropriate, between the subject/course contact and the community and workplace. Instructional and assessment strategies should be meaningful and consistent. All textbooks have to be accompanied by a teacher's resource guide.

Accountability

Assessment and accountability go hand in glove in Ontario. In the mid-90s a royal commission recommended the creation of an independent testing agency the responsibility of which would include the construction, administration, scoring and reporting of provincial primary and

secondary assessments in literacy and numeracy. From this recommendation came the creation of the Education Quality and Accountability Office (EQAO) in 1995, which is responsible for province-wide assessments in literacy and mathematics for students in Grades 3, 6, 9 and 10. The tests main objectives are to provide data that can be used both for accountability and improved teaching and learning. The EQAO's mandate is to:

> Ensure greater accountability and contribute to the enhancement of the quality of education in Ontario. This will be done through assessments and reviews based on objective, reliable and relevant information, and the timely public release of that information along with recommendations for system improvement (quoted in Volante 2007, 2).

Using the data and other information such as demographics and program descriptions, districts and schools prepare reports and school improvement plans. Assessment outcomes are published on the EQAO's website and reported widely in the media, which publish schools' rank order, somewhat like the performance tables in England. The EQAO has developed an Education Quality Indicators Framework that was more subtle than test data alone – it contained information gleaned from the student, teacher, and principal questionnaires that accompany the tests as well as from school board student information systems under the heading of four broad factors:

- contextual factors: describe the economic and social forces that have an effect on the education system, but are beyond the direct control of the system. These include enrolment, socio-economic status, country of birth and language background, categories of special needs, and student mobility
- input factors: describe the resources that go into the system. They include student attendance, support personnel, teachers' qualifications and experience, accessibility and use of instructional materials, and use of computers in selected subjects
- process factors: describe the activities resulting from the use and management of the input indicators within the school. Among these process factors are teachers' professional development, planning, and collaboration
- output factors: describe students' development while they are still in school, and include students' attitudes and achievement results (EQAO 2011).

Critics, such as Volante (2007), argued that Ontario needed to broaden its concept of accountability through assessment to include more curriculum-embedded assessment and performance-based skills. In 2013, the government introduced the K-12 *Effectiveness Framework*, which broadened the notion of what made a successful school. It includes:

- assessment for, as and of learning
- school and classroom leadership
- student engagement
- curriculum, teaching and learning

- pathways, planning and programming
- home, school and community partnerships.

Indicators of success in these areas are supposed to assist with strategic planning, the allocation of resources and determining capacity-building needs through school self-assessment and district reviews. Schools are encouraged to form professional learning communities (PLC), thus supporting professional accountability. Klinger et al (2011) express some skepticism about the framework, citing its complexity and the possibility that schools will not have the expertise to carry it out effectively.

Setting Standards

The MOE is responsible for financial allocation to elementary and secondary schools, and designing major policies in key issues such as curriculum and assessment, the teaching profession and accountability. Although curricular policy is in hands of the Ministry, Ontario has implemented curriculum reviews based on consultations with teachers and subject experts since 2003. The provincial government has determined that curriculum policy documents for each subject should be revised in a seven-year cycle to ensure that they remain current, relevant, age-appropriate and avoid content overcrowding. This also means that curriculum can be less political – the long lead times help prevent the hastily implemented "quick wins" that can be part of election promises.

Additionally, the MOE has created a curriculum council that advises it on policy issues for elementary and secondary curriculum. The council does not review the curriculum but provides advice and resources (working papers and other technical documents) for specific subjects and broader curricular issues (inclusive education, bullying or environmental education).

Similarly, the EQAO conducts all standardized assessments (literacy and numeracy testing) in the province. These standards are included in the curriculum policy documents and specify knowledge and skills in achievement charts. These standards are reviewed along with the curricula for each subject as part of the process described above.

The Ontario curriculum for elementary and secondary schools comprises *content standards* and *performance standards* (MOE 2011a). The content standards are the curriculum expectations identified for every subject and discipline and describe the knowledge and skills students are expected to develop and demonstrate in their class work, tests or other assessment activities. The performance standards are outlined in the achievement chart that appears in the elementary and secondary curriculum document for every subject area. This is a standard province-wide guide and is to be used by all teachers as a framework within which to assess and evaluate student achievement of the expectations in the particular subject.

The four achievement levels specified for elementary and secondary grades in each subject are:

- level 1 - achievement that falls much below the provincial standard (50%- 59%)
- level 2 - achievement that approaches the provincial standard (60% - 69%)
- level 3 - achievement at the provincial standard (70% - 79%)
- level 4 - achievement that surpasses the provincial standard (over 80%).

Level 3 is recognized as the satisfactory level to meet the requirements of the curriculum, however, students earns a course credit as long as they get Level 1. The standards are applied only to elementary school curricula. The secondary school system uses percentages to record students' academic achievement. This disconnect creates an obstacle for keeping the Ontario education system coherent throughout.

The Ontario curriculum also recognizes four categories of knowledge and skills that define the standards:

- knowledge and understanding: subject-specific content, and comprehension of its meaning and significance
- thinking: use of critical and creative thinking skills/processes
- communication: conveying of meaning in various forms (written, oral, visual)
- application: use of knowledge and skills to make connections within/between different contexts.

Teacher training

Initial Teacher Training

Teachers who work in publicly funded schools in Ontario must be certificated to teach in the province and be members of the Ontario College of Teachers. The College licenses, governs and regulates the Ontario teaching profession in the public interest. It accredits full- and part-time teacher education programs in university faculties of education in Ontario. These include publicly-funded universities, and several international schools, both off-shore institutions with campuses in Ontario (for example, Niagara University) and others operating outside of Canada (for example, Canisius College in New York State). The Ministry of Training, Colleges and Universities (MTCU) limits the number of teachers these institutions may certificate in any given year in an effort to prevent an over-supply of teachers.

The Ontario College of Teachers sets ethical standards and standards of practice, issues teaching certificates and may suspend or revoke them, accredits teacher education programs and courses and investigates and hears complaints about members (Ontario College of Teachers 2014).

To be certificated, teachers must have completed a minimum three-year postsecondary degree from an acceptable postsecondary institution and have successfully completed a one-year

acceptable teacher education program. As of 2015, the length of teacher preparation will increase to two years (Ontario College of Teachers 2014).

Faculties of education offer teacher education programs that are delivered consecutively and/or concurrently. A consecutive program is usually a one-year program leading to a Bachelor of Education pursued by teacher candidates after they have completed an undergraduate degree. Teacher candidates in a concurrent program complete a program leading to a Bachelor of Education while also completing an additional undergraduate degree in a discipline other than education. Teacher education programs completed in the English language qualify teachers to teach in the English-language system. Teacher education programs completed in the French language qualify teachers to teach in schools where French is the language of instruction.

The 2007 McKinsey report on PISA leaders emphasized that one factor that differentiated PISA leaders from those further down the rankings was the degree to which teacher education programs were able to draw their students from the top end of the talent pool (Barber and Mourshed 2007). Ben Levin suggests that Canadian applicants to teachers colleges are in the top 30% of their college cohorts and that the education within Canada's teacher training institutions is seen by some to be of high quality. Levin estimates there are perhaps 50 institutions across Canada, as opposed to hundreds across the United States, which allows for greater monitoring of training quality. Other commentators agree that teacher selectivity is high, but are more skeptical about the quality of the training institutions. (OECD 2012).

Continuous Professional Development

Between 2005 to 2007 the Ontario Minister of Education set up a working party to examine how professional development for teachers could be made most effective. These recommendations became the *Teacher Training and Leadership Program* (TLLP). The centerpiece of this framework is choice and coherence, programs that link ministerial, local and school priorities. TLLP suggests that professional development should be self-selected, attentive to adult learning styles, goal-oriented, sustainable and built on evidence-based research (Lieberman 2010).

Darling-Hammond (2013) characterizes Ontario's professional development as coordinated and coherent, with well-planned, high quality learning that is tailored to reflect current educational initiatives. She notes that teaching and leadership initiatives are monitored, evaluated and modified based on research evidence and on the ground feedback. There are six professional activity days each year so that teachers get the support they need to carry out their professional responsibilities – curriculum development, student evaluation, report writing and parental meetings. The MOE prescribes the topics for two of those days, based on its key priorities.

Upon entering the profession, all new teachers in publicly-funded schools must successfully complete the New Teacher Induction Program (NTIP)(Ontario MOE 2010b). The program includes orientation, mentoring and professional development, the last of which concentrates on key areas of new that new teachers have identified – classroom management, communication

with parents, assessment and evaluation (Pervin & Campbell 2011). New teachers receive professional development in core content areas such as literacy and numeracy strategies.

More experienced teachers also receive on-going professional development based on their teaching assignments, grade levels, position type, etc. In some cases highly skilled, experienced teachers provide on-the-job support for their colleagues in low performing school through sharing successful teaching and learning practices (Darling-Hammond 2013). Campbell (2014) writes about the Teacher Learning and Leadership Program (TLLP), which is a joint initiative of the Ontario Teachers' Federation and the MOE that provides funding for experienced teachers to develop and deliver innovative projects. The projects focus on teachers helping other teachers' professional capacity – knowledge, skills and practices – through, for example, creating and sharing lesson plans and assessment tools, integrating technology into teaching and using social media, such as blogs, to expand impact. The TLLP has created a provincial network of professional learning and collaboration within and outside teachers' own school boards.

Professional development takes place at the system level as well as school level. A Student Achievement Division (SAD) within the MOE promotes collaboration and sharing of strategies across Ontario. It has developed partnerships with school boards and together they analyze instructional and assessment practices at school and classroom level, with the aim of enhancing teaching and learning that will improve student achievement and engagement. These initiatives concentrate on students with the greatest needs and those who are the most at risk. SAD also promotes collaborative learning teams, for example in learning in mathematics and early primary, as well as school networks in order to foster a conducive climate for collaboration, planning and school improvement (Darling-Hammond 2013).

Teacher appraisal:
Ontario has a Teacher Performance Appraisal (TPA) system that is rooted in the encouragement of professional learning and growth and was developed in collaboration with key education stakeholders. Every five years experienced teachers are appraised by their principals based on sixteen competencies that were developed by the Ontario College of Teachers. Integral to the process for these teachers is an Annual Learning Plan, in which teachers outline their plans for professional growth; by collaborating on these plans, teachers and principals engage in on-going discussion and collaboration (Pervin & Campbell 2011). TPA includes pre-observation meetings, classroom observations, post observation meetings and summative reports. New teachers are appraised twice in their first year based on eight competencies.

Curriculum overview

The goals of the full day Kindergarten program are to:

- establish a strong foundation for the early years by providing young children with an integrated day of learning
- provide a play-based learning environment
- help children make a smoother transition to Grade 1
- improve children's prospects for success in school and in their lives beyond school.

The curriculum is play-based and concentrates on six learning areas: personal and social development; language; mathematics; science and technology; health and physical activity; and the arts (MOE 2011b).

Grades 1 through 8 must offer instruction in the arts, French as a second language (for English language schools), health and physical education, language, mathematics, science and technology and social studies. In Grades 7 and 8 international languages and work related activities may be offered and social studies can be separately taught as history and geography. Subjects do not necessarily have to be separate – it is possible to offer inter-disciplinary learning.

In order to graduate from high school students must complete the following compulsory courses:

- four credits in English (one credit per grade), which may come from successful completion of the *Ontario Secondary School Literacy Course* (OSSLC) to meet either the Grade 11 or Grade 12 requirement or the Grade 11 *Contemporary Aboriginal Voices* course
- three credits in mathematics, with at least one credit in Grade 11 or 12
- two credits in science
- one credit in the arts, which may come from the Grade 9 *Expressing Aboriginal Cultures* course
- one credit in Canadian geography (Grade 9)
- one credit in Canadian history (Grade 10)
- one credit in French as a second language (or a Native language course)
- one credit in health and physical education
- half a credit in career studies
- half a credit in civics.

In addition, students must complete three additional credits consisting of one credit from each of the following groups:

- Group 1: English (including the *Ontario Secondary School Literacy Course*, for those who failed the OSSLT and opted to take the course instead of repeating the test), French as a second language, classical languages, international languages, Native languages, Canadian and world studies, Native studies, social sciences and humanities, guidance and career education, cooperative education

- Group 2: French as a second language, the arts, business studies, health and physical education, cooperative education
- Group 3: French as a second language, science (Grade 11 or 12), computer studies, technological education, and cooperative education.

Finally, students also must earn 12 optional (or elective) credits. Courses can vary according to each school's program and can be locally developed.

In order to pass a course for credit, students must achieve at least a 50% mark.

As noted above, there are a variety of pathways open for students to follow in Grades 9 through12. Schools boards are required to ensure that students in Grades 11 and 12 have access to an appropriate destination-related course in at least English, mathematics, and science (MOE 2011b).

Language of instruction

The main language of instruction in Ontario is English but there is provision for instruction in French. Twelve of Ontario's 72 school boards are francophone – four public and eight Catholic – comprising 425 French-language schools. The curriculum in these schools is taught exclusively in French, with the exception of English language courses. A student has a right to French language instruction if his or her parent or guardian's native language is French or s/he has received an elementary education in a French-language institution in Canada.

Assessment processes

The fundamental principles that underpin both formative and summative assessment in Ontario are that assessments:

- are fair, transparent, and equitable for all students
- support all students, including students with special education needs, those who are learning the language of instruction, and those who are First Nation, Métis, or Inuit
- are carefully planned to relate to the curriculum expectations and learning goals and, as much as possible, to the interests, learning styles and preferences, needs, and experiences of all students
- are communicated clearly to students and parents at the beginning of the school year or course and at other appropriate points throughout the school year or course
- are ongoing, varied in nature, and administered over a period of time to provide multiple opportunities for students to demonstrate the full range of their learning
- provide ongoing descriptive feedback that is clear, specific, meaningful, and timely to support improved learning and achievement

- develop students' self-assessment skills to enable them to assess their own learning, set specific goals, and plan next steps for their learning (MOE 2011a).

Recent research in education, as reflected in the ministry policy document *Growing Success: Assessment, Evaluation, and Reporting in Ontario Schools* (MOE 2010a), has focused on three types of assessment: assessment for learning, assessment as learning, assessment of learning.

- *assessment for learning* is designed to give teachers information to modify and differentiate teaching and learning activities. It acknowledges that individual students learn in idiosyncratic ways, but it also recognizes that there are predictable patterns and pathways that many students follow. It requires careful design on the part of teachers so that they use the resulting information to determine not only what students know, but also to gain insights into how, when, and whether students apply what they know. Teachers can also use this information to streamline and target instruction and resources, and to provide feedback to students to help them advance their learning
- *assessment as learning* is a process of developing and supporting metacognition for students. Assessment as learning focuses on the role of the student as the critical connector between assessment and learning. When students are active, engaged, and critical assessors, they make sense of information, relate it to prior knowledge, and use it for new learning. This is the regulatory process in metacognition. It occurs when students monitor their own learning and use the feedback from this monitoring to make adjustments, adaptations, and even major changes in what they understand. It requires that teachers help students develop, practice, and become comfortable with reflection, and with a critical analysis of their own learning
- *assessment of learning* is summative in nature and is used to confirm what students know and can do, to demonstrate whether they have achieved the curriculum outcomes, and, occasionally, to show how they are placed in relation to others. Teachers concentrate on ensuring that they have used assessment to provide accurate and sound statements of students' proficiency, so that the recipients of the information can use the information to make reasonable and defensible decisions.

In secondary school, students work towards graduation by obtaining the Ontario Secondary School diploma (OSSD). The OSSD requires students to obtain 30 credits (18 compulsory and 12 elective), meet the provincial literacy requirements in a test in Grade 10 (Ontario Secondary School Literacy Test (OSSLT)) and complete 40 hours of community involvement activities.

There are several routes which students can take in order to continue into further or higher education:

The Specialist High Skills Major (SHSM) program, which is career-focused and involves meeting the same requirements for OSSD; students achieving the OSSD with a SHSM get a special qualification in their diplomas. Each SHSM program consists of the following five required components:

- a defined bundle of credits consisting of eight to ten Grade 11 and Grade 12 credits, including two cooperative education credits
- certification and training recognized within the sector
- experiential learning and career exploration activities appropriate to the sector
- reach-ahead experiences connected to the student's postsecondary plans
- essential skills and work habits required in the sector and recorded in the Ontario Skills Passport (OSP) (Government of Ontario 2010).

Students can also apply for an *Ontario Secondary School Certificate* (OSSC) when they turn 18 years of age and have collected a minimum of 14 credits (seven compulsory and seven elective).

Students can apply for the *Ontario Youth Apprenticeship Program* (OYAP) after they have reached age 16 and completed a cooperative education program in apprenticeship.

Those students who turn 18 and have obtained fewer than 14 credits can obtain a *Certificate of Accomplishment* (MOE, 2011b).

Assessment

Province-wide standardized testing began in 1996 in several grades and in a range of subjects, with both a summative and formative purpose (Andrews et al 2007). The literacy tests – the OSSLT – are developed according to frameworks that are benchmarked both nationally and internationally. The test items are developed, under the aegis of the EQAO, by Ontario educators and include extensive field-testing. The markers for the open-ended questions are by and large Ontario educators and the tests are double marked. Statistical equating with past tests is carried out to ensure standards over time and comparability. As with PISA, TIMSS and PIRLS assessment, the provincial assessments are accompanied by student, teacher and principal questionnaires that are intended to improve practice (EQAO 2012).

For Grades 1 to 12, assessment is based on evidence of student achievement of the provincial curriculum expectations as outlined above. As essential steps in assessment *for* learning and *as* learning, which are as much about pedagogy as assessment, teachers need to:

- plan assessment concurrently and integrate it seamlessly with instruction
- share learning goals and success criteria with students at the outset of learning to ensure that students and teachers have a common and shared understanding of these goals and criteria as learning progresses
- gather information about student learning before, during, and at or near the end of a period of instruction, using a variety of assessment strategies and tools
- use assessment to inform instruction, guide next steps, and help students monitor their progress towards achieving their learning goals
- analyze and interpret evidence of learning
- give and receive specific and timely descriptive feedback about student learning

- help students to develop skills of peer and self-assessment (MOE, 2010a).

Currently the following tests developed by the EQAO are given to all students in Ontario:

- assessment of reading, writing and mathematics primary division (Grades 1-3): three test booklets, two for English and one for mathematics that are six hours long (two hours for each booklet)
- assessment of reading, writing and mathematics junior division (Grades 4-6): three test booklets, two for English and one for mathematics that are six hours long (two hours for each booklet)
- Grade 9 assessment of mathematics: two test booklets of 60 minutes' duration each
- Ontario secondary school literacy test (OSSLT) (Grade 10): two test booklets of 75 minutes duration each.

The tests contain both multiple choice and open ended items (including short and long essays). Results are reported as overall achievement levels, from 1 to 4 with Level 1 being the lowest and Level 4 the highest for the primary, junior and Grade 9 assessments. Sublevels (1.1, 1.3, 1.5, 1.7, 1.9) are also reported so that end users can determine where a student's performance sits within the achievement level. Such fine grained data are supposed to be used by schools to make decisions about placement, intervention programs, school organization and program planning. Students are reported as either 'successful' or 'unsuccessful' in the OSSLT.

International testing

PISA 2012	Score	Rank: CANADA	Point difference highest (95%)/ lowest (5%) achievers	Below level 2 (basic skills for life and work)	Levels 5 and 6 (top performers)
Mathematical Literacy	514	13th of 65	290 points OECD = 302	14% OECD = 23%	15% OECD = 13%
Reading	528	9th of 65	306 OECD = 310	10% OECD = 18%	14% OECD = 8%
Scientific Literacy	527	10th of 65	309 OECD = 304	11% OECD = 18%	12% OECD = 8%
Problem Solving	528	8th of 44		15%	19%

Ontario's PISA results are not statistically significantly different from Canada's overall in any of the subject areas. The points differences between its highest and lowest achievers, which the OECD uses as a measure of educational equity, i.e., the lower the point difference, the closer educational opportunities are for all students, is slightly lower than the OECD average, except for science, which is slightly higher. However, between 2003 and 2012, Ontario's performance

in mathematics declined by 16 points, reading scores declined by five points between 2000 and 2012 and science scores declined by 10 points between 2006 and 2012 (OECD 2014b, OECD 2013).

PIRLS and TIMSS 2011

	Score	Rank	Advanced International Benchmark (625)	Low International Benchmark (400)
PIRLS 4th Grade	552	12th of 45 (Canada)	15% International Median = 8%	97% International Median = 95%
TIMSS math 4th Grade	518	21st of 57	7% International Median = 4%	94% International Median = 90%
TIMSS math 8th Grade	512	17th of 56	4% International Median = 3%	94% International Median = 75%
TIMSS science 4th Grade	528	18th of 57	9% International Median = 5%	94% International v = 92%
TIMSS science 8th Grade	521	20th of 56	9% International Median = 4%	94% International Median = 79%

Ontario has participated in PIRLS since 2001, during which time its score increased by 4 points. Participants did better on literary than on informational reading. Canada did not take part as a country in TIMSS 2011; instead Alberta, Ontario and Quebec participated as benchmarking entities. Ontario's scores in 4th Grade mathematics, 8th Grade mathematics, 4th Grade science and 8th Grade science have increased since 1995 by 29, 11, 12 and 25 points respectively. However, its performance since 2003 has been relatively flat (Martin et al 2012, Mullis et al 2012 PIRLS, Mullis et al 2012 TIMSS).

National Academic Achievement Testing

Since 1993, Ontario has participated in School Achievement Indicators Program (SAIP), conducted across Canada by CMEC. Through SAIP, CMEC administered assessments of achievement in mathematics, reading/writing, and science for students aged 13 and 16 across Canada. The program was replaced in 2007 with the Pan-Canadian Assessment Program (PCAP), which assesses Grade 8 (age 14) students. The purpose of both SAIP and PCAP was to give provinces and territories an insight into their curricula and to compare student achievement across Canada. PCAP complements provincial assessments; the tests were developed by teachers working with CMEC. Results are available at provincial/territorial level only – students, schools and district information is not available.

PCAP includes mathematics, reading, and science in each assessment, one being the major area and the other two being the minor areas to be assessed. The first PCAP assessment was

administered in 2007 with a focus on reading. The second PCAP was administered in spring 2010 with a focus on mathematics.

In 2010 Ontario had results above the Canadian average (set to 500) in mathematics, with a score of 507, in science, with a score of 510 and in reading, with a score of 515. The Ontario average in reading was higher than those for all other jurisdictions. Ontario was the only province with results above the Canadian average in all three subjects. In 2007, Ontario was at the Canadian average in all three subjects.

In 2010 mathematics, the major component, 92% of Ontario students achieved Level 2 – the expected level of performance for Grade 8 students – or above; 5% reached level 4 (EQAO 2011).

Detailed analysis of curriculum

In this section, the following key areas of the Ontario curriculum have been analyzed: elementary English language, mathematics, general science and history, and secondary language, mathematics, earth science, biology, chemistry, physics, history and geography (social studies) and vocational education. The areas of the analysis are:

- orientation – the aims, goals and rationale for the subject/content area
- coherence and clarity – the extent to which the curricula contain clear and specific goals for each grade and whether the suggested learning activities and pedagogical materials support those goals
- scope – the scope of material coverage, the number or amount of items or goals in the curriculum versus the depth of mastery proposed of each one
- levels of difficulty – to what extent the curricula items can be judged to be at the appropriate levels of difficulty. An appropriate level of difficulty should be defined as one that builds sequentially on prior and existing knowledge and presents an achievable challenge to the average student
- integration – how the different subjects within each grade of the curriculum is internally aligned
- progression – how smoothly and coherently the learning goals and proposed content of a given curriculum in a given subject progress from one grade level to the next
- key competencies – the level of development of a number of key competencies in the current curriculum and textbooks (such as problem solving, teamwork, self-learning, creativity, critical thinking competencies).

Student pathways in Ontario

The transition between elementary and high school comes after Grade 8, so the primary/elementary phase is different for Ontario compared with Alberta. For students in Grade 9 - 10 there are three pathways they might follow (academic, applied and open), and for Grades

11 – 12 there are five pathways (college preparation, university preparation, college/university preparation, workplace preparation and open).

Elementary: English education

Orientation:
The elementary curriculum contains a holistic vision of the role of language and literacy in children's development and the ways in which development in one enhances development in the other: "Literacy learning is a communal project and the teaching of literacy skills is embedded across the curriculum; however, it is the language curriculum that is dedicated to instruction in the areas of knowledge and skills – listening and speaking, reading, writing, and viewing and representing – on which literacy is based."

> Language development is central to students' intellectual, social, and emotional growth, and must be seen as a key element of the curriculum. When students learn to use language in the elementary grades, they do more than master the basic skills. They learn to value the power of language and to use it responsibly. They learn to express feelings and opinions and, as they mature, to support their opinions with sound arguments and research.

Coherence and Clarity:
The language curriculum is organized into four strands:

- oral communication
- reading
- writing,
- media literacy.

The curricula for each strand are organized around core expectations for what students can do that are constant across grades, for example, for reading, students will:

- read and demonstrate an understanding of a variety of literary, graphic, and informational texts, using a range of strategies to construct meaning
- recognize a variety of text forms, text features, and stylistic elements and demonstrate understanding of how they help communicate meaning
- use knowledge of words and cueing systems to read fluently
- reflect on and identify their strengths as readers, areas for improvement, and the strategies they found most helpful before, during, and after reading.

In each grade, these core areas of activity are broken down into specific competencies expressed in terms of what the child will be able to do for example under 1. Reading for meaning:

Making Inferences / Interpreting Texts 1.5: make inferences about texts using stated and implied ideas from the texts as evidence.

Competencies are accompanied by brief examples of how teachers can support their development within each grade.

Scope:

There is both depth and breadth to the curriculum with the emphasis in the curriculum specification on the desired end competencies that students should develop and the experiences from which they will be built. This is preferred to the specification of content to be delivered by the teacher, defined in terms of text types to be covered or narrowly defined skills (word level skills in Grade 1 are not defined in terms of systematic phonics and the sequence in which they should be taught, for instance, rather, the stated goals are expressed in terms of student outcomes; for example to recognize and be able to process high frequency words and predictable language structures).

Levels of Demand:

Levels of demand are appropriate and show progressive development, leaving room for the teacher to interpret how to support students working at different levels, while keeping the broader goals in mind

Progression:

Consistency in how the learning goals are defined lead to strong indicators of progression at the level of the student.

Assessment:

The assessment arrangements align with the curriculum, in so far as the curriculum is not driven by summative high stakes tests. Instead an assumption of high levels of professional knowledge on the part of teachers that allows them to adapt pedagogy in the light of on-going, classroom-based formative assessment underpins the curriculum specification.

This relationship between assessment and the curriculum changes in Year 9. From Year 9 onwards the curriculum is shaped by the end of stage examination and defined in terms of the content of the exam, not the competencies of students. This produces a certain amount of discontinuity between phases (see below under integration).

Key competencies

Key competencies for the language and literacy curriculum in the primary phase focus on extending the range of children's competencies as creative speakers, readers and writers, and intelligent makers and consumers of digital and media texts.

Integration:

In the primary phase the four strands of oral communication, reading, writing, and media literacy are well integrated, and planned to develop alongside each other in ways that are mutually supportive and extend students' competencies.

From Grade 9 onwards, the examination curriculum is divided into three different routes, defined by the end points envisaged: academic; applied; open. So the examination system streams students and sets them towards different kinds of study goals, in the same four strands that constitute the curriculum: oral communication, reading and literature studies, writing, and media literacy. The summative assessment varies the depth of skill students are expected to show. The skills remain generic, rather than tied to particular content, for example, for the academic strand:

> Critical Literacy 1.8: identify the perspectives and/or biases evident in both simple and complex texts and comment on any questions they may raise about beliefs, values, and identity (e.g., compare the depiction of an issue in a young adult novel and the depiction of the same issue in a newspaper report).

Elementary: Mathematics

Orientation:
Early on in the curriculum document there is a statement about the importance of mathematics. It moves on to say that students need classroom experiences that that help them:

- develop mathematical understanding
- learn important facts skills and procedures
- develop the ability to apply the processes of mathematics
- acquire a positive attitude towards mathematics.

Coherence and Clarity:
At each grade, overall expectations are given briefly and this is built on with specific expectations that include examples of appropriate activities. The specific expectations match the overall expectations.

Scope:
The Ontario curriculum document used here is for Grades 1-8 (6-13 year olds). Four and five year olds are described as in early childhood and secondary starts at age14. For each of the Grades 1-8, content is described twice, firstly in fairly general overall expectations and then in more detailed specific expectations. In addition to content strands there are seven mathematical process expectations (see key competencies below for more on process expectations). The specific expectations for each grade are organized in five strands:

- number sense and numeration
- measurement
- geometry and spatial sense
- patterning and algebra

- data management and probability.

The curriculum document includes statements about the importance of these strands. It also states that mathematical processes cannot be separated from knowledge and skills.

At Grade 1, work on number sense and numeration involves representing and ordering whole numbers to 50 and working with money up to 20 cents. Children also count in twos, fives and tens, and add and subtract to 20. The specific expectations related to this give detail of appropriate activities and resources. For example, children use practical objects such as cubes and representations such as number lines and hundred charts. Work on addition and subtraction includes simple problem-solving and use of concrete materials, representations or mental strategies. The measurement work at Grade 1 is about use of non-standard units and telling time to the half-hour. The specific requirements suggest a range of appropriate practical activities and also encourage estimation and discussion of results. Work on geometry and spatial sense in Grade 1 includes sorting and classifying 2D and 3D shapes, recognizing symmetry and using the language of position. The specific expectations suggest the shapes that might be used and the criteria for sorting. There are mentions of practical work and appropriate discussion. Grade 1 work in patterning and algebra is about creating and extending repeating patterns and understanding the concept of equality using concrete materials. Examples of repeating patterns are given together with activities related to the idea of equality in relation to balance. Data management and probability involves organizing and categorizing objects and displaying data using graphs and pictographs. Students also describe the likelihood of events occurring. The specific expectations suggest sample activities, as well as giving more detail, such as the suggestion that students make tally marks in data handling and use words such as “unlikely” or “certain” in probability.

Grade 2 children extend work on number sense and numeration to include counting and ordering numbers up to a hundred and further work on money. They work with two-digit numbers, including addition and subtraction, in a variety of ways. They investigate fractions of a whole. Students count in twos, fives, and twenty-fives and start to explore multiplication and division through equal sized groups and equal shares. The measurement strand at this grade involves standard units of length and non-standard units for perimeter, area, mass and capacity. Students compare mass and capacity of objects using non-standard units. They work with temperatures, tell time to the nearest quarter-hour and work with days, months, weeks and years. In geometry, students classify 2D and 3D shapes and compose and decompose shapes. They locate lines of symmetry and describe relative locations and paths of motion. Patterning and algebra involves repeating patterns and growing and shrinking patterns. Students further develop their understanding of equality and make use of the commutative property. Data management includes organizing objects according to two attributes. Students are introduced to a range of ways of representing data, including line plots and simple bar graphs. Students describe probability in relation to simple games and experiments. The specific expectations continue to provide a range of sample activities and generally promote practical work and discussion.

Grade 3 students extend their work on number to include numbers to a thousand. They also work with fractions of a set. They add and subtract three digit numbers in a variety of ways and relate simple multiplication and division calculations to real-life situations. Measurement includes working with a range of standard units such as kilometers, kilograms and liters as well as measuring area using grid paper. Students tell the time to the nearest five minutes. In geometry, they are introduced to right angles and they classify 2D and 3D shapes by geometric properties. They name different types of quadrilaterals and prisms and pyramids. They identify congruent shapes, describe movement on a grid map and recognize transformations. Students further develop their work with growing and shrinking patterns and also represent geometric patterns using number sequences, number lines and bar graphs. They determine the missing numbers in equations involving addition and subtraction and investigate the problems of zero and one in multiplication. In data management, students use vertical and horizontal bar graphs and sort into categories using two or more attributes. They also work with mode. In probability, they predict frequencies and relate fair games to equally likely events.

At Grade 4, students deal with numbers up to 10,000. They represent and compare fractions and relate halves, fifths and tenths to decimals. They add and subtract three-digit numbers in a variety of ways and multiply and divide two-digit by one-digit numbers. Students use a wider range of measuring units, including millimeters and milliliters. They measure mass and capacity using standard units and work on the area and perimeter of rectangles. They measure time to the nearest minute. Students work with geometric properties of 2D shapes including parallelograms and classify 3D shapes including prisms and pyramids by geometric properties. They construct three-dimensional figures, describe location on a grid system and describe reflections. In patterning and algebra, students use term numbers in numeric sequences and generate patterns involving addition, subtraction, multiplication and reflection. They determine the missing numbers in equations involving multiplication and use commutative and distributive properties to facilitate computation. Data management is extended to include stem and leaf plots, double bar graphs, understanding median and comparing related sets of data. In probability, they predict the frequency of outcomes and investigate how repetition of experiments affects conclusions.

At Grade 5, students extend their use of the whole number system and of decimals to two places. They compare and order fractions with like denominators and add and subtract decimals to two places. They multiply two-digit by two-digit numbers and divide three-digit by one-digit numbers. They relate simple fractions to decimals. In measurement, students work with time and temperature. They also develop their understanding of area and perimeter and relate capacity to volume. They develop and apply the volume relationship for a right rectangular prism. In geometry, students work with polygons and prisms. They extend work on angles to include measuring with a protractor. They construct triangles and nets of prisms and pyramids and describe translations. In patterning and algebra, students represent patterns using a table of values. They predict terms and determine missing numbers in equations. They investigate variables as unknown quantities and demonstrate equality using multiplication or division. In data management, students collect and organize discreet and continuous data and

use displays including broken line graphs. They understand mean, compare sets of data and represent probability using fractions.

At Grade 6, students extend their use of whole numbers, decimals and fractions. They work with percentages. Calculations involve addition and subtraction of decimals, multiplication and division of four-digit by two-digit numbers, multiplication and division of one place decimals by whole numbers and division of three-digit numbers by one-digit numbers. Students apply order of operations in expressions without brackets and relate simple fractions, decimals and percentages. In measurement, students use a range of metric units and convert between units, including square meters to square centimeters. They work with the area of parallelograms and triangles, the volume of triangular prisms and the surface area of rectangular and triangular prisms. In geometry, they classify quadrilaterals by geometric properties and polygons by lines of symmetry and rotational symmetry. They measure angles to 180 degrees using protractors, construct polygons, represent 3D shapes in a range of ways, perform rotations and plot points in the first quadrant. In algebra, they use ordered pairs, describe patterns in words, calculate terms given the term number, investigate variables and solve equations, for example by guess and check. In data management, students collect and organize discreet and continuous data and use a range of graphical representations. They use mean to compare sets of data. They find theoretical probabilities and use this to predict frequency.

In number sense and numeration, Grade 7 students represent and order decimals (to two places), fractions and integers. They represent squares and square roots. They carry out a range of calculations using whole numbers, fractions and decimals, including addition and subtraction of simple fractions and of integers. They multiply and divide decimals by single-digit numbers and apply order of operations in expressions with brackets. They relate fractions to decimals and percentages and solve problems using percentages and unit rates. In measurement, students convert between metric units and develop the area relationship for a trapezoid. They use the formula for the volume of a prism and work with the surface area of prisms. In geometry, students construct parallel, perpendicular and intersecting lines. They sort and classify triangles and quadrilaterals and construct angle bisectors and perpendicular bisectors. They investigate congruent shapes, enlargements and similar shapes. Students work with tiling the plane and plot points in all four quadrants. In patterning and algebra, students represent growing patterns and represent patterns algebraically. They model relationships involving constant rates and use algebraic expressions. They find a term in a pattern algebraically and solve linear equations, for example, by inspection or guess and check. In data management, students use a range of ways of representing data, including circle graphs. They identify the bias in data and relate changes in data to central tendency. They investigate applications of probability and determine the probability of two independent events.

In Grade 8 number, students represent and order rational numbers and represent numbers using exponential notation. They solve number problems using all four operations. They multiply and divide fractions and integers and multiply then divide decimals by powers of ten. They apply order of operations in expressions with brackets and exponents. They solve problems involving percentage, rates and proportions. In measurement, students convert

between units, for example cubic centimeters and cubic meters. They develop circumference and area relationships for a circle, the formula for the volume of a cylinder and for the surface area of cylinders. In geometry, students sort quadrilaterals, construct circles and investigate similar shapes and angle relationships for parallel and intersecting lines. They relate the number of faces, edges and vertices of a polyhedron and use the Pythagorean relationship. They plot the image of points after transformation. In patterning and algebra, students represent the general term in a linear sequence using algebraic expressions and find the term number in a pattern algebraically. They solve linear equations involving one variable using a balance model. Data management involves organizing data into intervals and displaying data using histograms and scatter plots. Students use measures of central tendency to compare data sets. They compare experimental and theoretical probabilities and calculate the probability of complementary events.

Levels of Demand:
Progression between grades is clear and sequential. There is enough revisiting to allow for some differentiation. Compared with other countries, the level of demand is quite interesting, as it appears high in some respects and low in others. For example, lower grades contain less work on fractions than many other countries. Sometimes, things at the same grade appear to be at very different levels of difficulty. For example, at Grade 4, students measure time to the nearest minute, but also calculate the area and perimeter of rectangles and identify properties of parallelograms. Not surprisingly, higher grades contain content that would be seen as appropriate for secondary students in most countries, this is appropriate to the age of students. However, at this level there are also some interesting points related to degree of difficulty, for example addition of fractions appears at Grade 8 along with multiplication. Personal correspondence from one of our reviewers stated that therefore, students seem to struggle later. Also there is a significant leap in the degree of difficulty in Grade 9 onward. Another issue is the use of calculators in mathematics classrooms. Students are encouraged to use calculators before they develop a full understanding of number. Multiplication by powers of ten and introduction of mode and median also come later than might be expected. The measuring and geometry content is quite demanding at lower levels. There is perhaps less emphasis on number at lower grades than in some countries.

Progression:
Progression is clear between grades and there is some revisiting. Our reviewer noted that parents and educators share some concerns about progression as students struggle seriously with math when they enter Grade 9 (unless they did extracurricular math lessons).

Assessment:
The sample assessment for Grade 3 includes a range of non-number questions. It is stated that number calculations will also be included. Examples of these are not provided, but an indication of the types of calculation is given. The tests appear to match the curriculum.

Key competencies:
There are seven mathematical process expectations. These are:

- problem-solving
- reasoning and proving
- reflecting
- selecting tools and computational strategies
- connecting
- representing
- communicating.

At each grade, detail is provided of how the mathematical process expectations can be integrated into student learning at this grade.

Elementary: Science

The curriculum for science education in Ontario is incorporated within the program for science and technology.

Orientation:
The introductory sections of the curriculum framework set out explicitly and in detail the goals of the science and technology program, the "big ideas" that underpin the program and the responsibilities of different stakeholders – students, parents, teachers, principals and community partners.

The overarching objective of the curriculum is to foster scientific and technological literacy to inform the responsible use of scientific and technological knowledge and skills in students' everyday lives as individuals and citizens. The three main goals are:

- to relate science and technology to society and the environment
- to develop the skills, strategies and habits of mind required for scientific inquiry and technological problem solving
- to understand the basic concepts of science and technology.

Coherence and Clarity:
The science and technology curriculum document is set out very clearly with coherence between the different elements. The introduction to the curriculum outlines the goals for science and technology and indicates perspectives on the nature of science and technology that have informed the development of the curriculum. There is an emphasis on developing students' understandings of the nature of science and technology as well as deepening understandings of fundamental concepts related to matter, energy, systems and interactions, structure and function, sustainability and stewardship and change and continuity.

These dimensions are reflected in curriculum expectations that set out the major areas of knowledge and skills in the curriculum divided into four strands:

- understanding life systems
- understanding structures and mechanisms
- understanding matter and energy
- understanding earth and space systems.

Science and technology are integrated in these strands and associated expectations.

The skills continua for Scientific Inquiry and Technological Problem Solving are set out for three areas:

- scientific inquiry / experimentation skills
- scientific inquiry / research skills
- technological problem solving skills.

The continua for each set of skills outline expected progression across Grades 1 – 8. These then inform the list for topics and detailed expectations set out for each grade level. These include an overview of the topic, a list of *Big Ideas* to be developed in each topic connected to the fundamental concepts outlined in the introduction to the curriculum, and overall expectations of what children will achieve in each strand at the end of the grade (three for each strand). These are followed by a series of specific expectations under the headings:

- relating science and technology to society and the environment
- developing investigation and communication skills
- understanding basic concepts.

Supported by examples of possible responses that would fulfill these expectations and sample guiding questions for teachers.

Brief advice in the document concerning assessment and instructional approaches is consistent with the orientation and goals of the curriculum in the emphasis on the development of skills as well as knowledge and understanding and on application in varied contexts. While there are no specific expectations set out concerning the development of attitudes in science and technology, the introduction to the guidance on instructional approaches also emphasizes the need to foster curiosity and wonder.

Scope:
A breadth of content is addressed at each grade level related to life systems, structures and mechanisms, matter and energy and Earth and space systems, with associated expectations linked to relating science and technology to society and the environment, developing investigations and understanding basic concepts.

There is also breadth in the skills children are expected to develop. The continua related to skills development indicate that the progress of children across all grade levels should be reviewed in relation to initiating and planning, performing and recording, analyzing and interpreting and communicating.

Skills and concepts in science and technology are integrated in the requirements for each grade. There are no expected outcomes set out explicitly for the development of attitudes and values, although expectations related to the fundamental concept of sustainability and stewardship include attitudes toward the environment.

Level of demand:
As indicated above, children are expected to demonstrate a broad range of inquiry skills from the first grade (including the analysis and interpretation of data). They are also expected to be able to assess relationships and applications to everyday life (this is a distinctive feature of curriculum requirements). Conceptual content is detailed and demanding in comparison to curricula in some other jurisdictions going beyond ideas that can be gained through experience of patterns in natural phenomena, for example at the end of Grade 1 children are expected to:

> Demonstrate an understanding that energy is something that is needed to make things happen, and that the sun is the principal source of energy for the earth.

Or at Grade 5:

> Demonstrate an understanding of the structure and function of human body systems and interactions within and between systems.

Progression:
Progression in relation to skills is indicated in the skills continua set out for scientific inquiry and technological problem solving that identify progression in initiating and planning, performing and recording, analyzing and interpreting and communicating.

Progression in concepts is indicated in the sequence of topics and associated overall expectations for each strand for each grade in the curriculum, for example, in Life Systems from Needs and Characteristics of Living Things at Grade 1 (demonstrate an understanding of the basic needs and characteristics of plants and animals) to Biodiversity at Grade 6 (demonstrate an understanding of biodiversity, its contributions to the stability of nature systems and its benefits to humans) or in understanding earth and space from Daily and Seasonal Changes (demonstrate an understanding of what daily and seasonal changes are and of how these changes affect living things) to Space (demonstrate an understanding of components of the systems of which the earth is a part, and explain phenomena that result from the movement of different bodies in space). This illustrates the greater emphasis on systems and interconnections in the later grades.

Assessment:
The curriculum document outlines the purposes of assessment, referring to the ways in which assessment information can help determine students' strengths and weaknesses against curriculum expectations as well as guide teachers in developing their curricula and evaluating the effectiveness of programs and classroom practices.

Assessment and evaluation are based on curriculum expectations and achievement levels in the document. A range of approaches is advocated. Students are to be provided with descriptive feedback to guide improvement both in relation to both what they learn and how they learn. Teachers are also expected to evaluate the quality of students' work allocating a letter grade. The characteristics of achievement chart sets out broad criteria that can be applied at any grade in relation to:

- knowledge and understanding
- thinking and investigation
- communication
- application.

This is again aligned with the goals and framework for the curriculum in including both skills and knowledge and understanding in science and technology and in giving emphasis to applications.

There are four levels of achievement. Level 1 is much below the standard and Level 2 approaching the standard. Level 3 indicates a student is prepared for work in the next grade and Level 4 indicates ability to use knowledge and skills for the grade in more sophisticated ways. Exemplar materials are provided to support assessment processes.

Key competencies:
There is a section in the science and technology curriculum document on *Cross-curricular and Integrated Learning*. This refers to the opportunities for environmental education within the science and technology curriculum. Opportunities for the development of critical thinking and critical literacy and for the use and development of skills in literacy, numeracy and ICT are identified.

Secondary: English education

Orientation:
The MOE states of the English curriculum:

> Literacy development is a communal project, and the teaching of literacy skills is embedded across the Ontario curriculum. However, it is the English curriculum that is dedicated to developing the knowledge and skills on which literacy is based – that is, knowledge and skills in the areas of listening and speaking, reading, writing, and viewing and representing. Language development is central to students' intellectual, social, cultural, and emotional growth and must be seen as a key component of the curriculum. When students learn to use language, they do more than master the basic skills. They learn to value the power of language and to use it responsibly.

Language is a fundamental element of identity and culture. Students read and reflect on a rich variety of literary, informational, and media texts. It is claimed that the English curriculum takes

into account that students in Ontario come from a wide variety of backgrounds, notably French speaking and Aboriginal peoples, but by far the greatest emphasis is on teaching English as the mother tongue. The system, however, promotes a great deal of teacher autonomy which may adapt to localized circumstances. It is recommended that reading activities should expose students to materials that reflect the diversity of Canadian and world cultures, including those of Aboriginal peoples.

In classifying the curriculum, reading is brought together with the study of literature under the heading reading and literature studies, which aims for students to:

> develop a deeper understanding of themselves and others and of the world around them. If they see themselves and others in the texts they study, they will be more engaged in learning and they will also come to appreciate the nature and value of a diverse, multicultural society.

The other three categories of the compulsory courses of the English curriculum are oral communication, writing, and media studies. The program in all grades is designed to develop a range of essential skills in these four strands. They are intended to develop knowledge of the conventions of standard English, and the use of analytical, critical, and metacognitive thinking skills.

Students are encouraged to understand that language learning is a necessary, life-enhancing, reflective process. The important skills are to read, listen, view, speak, write, and represent. Students should: make meaningful connections between themselves, what they encounter in texts, and the world around them; think critically; understand that all texts advance a particular point of view that must be recognized, questioned, assessed, and evaluated; appreciate the cultural impact and aesthetic power of texts; use language to interact and connect with individuals and communities, for personal growth, and for active participation as world citizens.

Coherence and Clarity:
The programs of study are issued by the MOE. They are specified to a very high level of detail. They represent an exhaustive specification of language skills, with consistent themes running through the levels, but with added sophistication at each stage.

In the core English curriculum the specifications refer to standard sets of knowledge and skills required for effective listening and speaking, reading, writing, and viewing and representing. However, the course outline at each grade is grouped in the strands of oral communication, reading, writing, and media literacy skills.

For example, at Grade 10, the required skills are described as:

- listening to understand: listen in order to understand and respond appropriately in a variety of situations for a variety of purposes

- speaking to communicate: use speaking skills and strategies appropriately to communicate with different audiences for a variety of purposes
- reflecting on skills and strategies: reflect on and identify their strengths as listeners and speakers, areas for improvement, and the strategies they found most helpful in oral communication situations
- reading for meaning: read and demonstrate an understanding of a variety of literary, informational, and graphic texts, using a range of strategies to construct meaning
- understanding form and style: recognize a variety of text forms, text features, and stylistic elements and demonstrate understanding of how they help communicate meaning
- reading with fluency: use knowledge of words and cueing systems to read fluently
- reflecting on skills and strategies: reflect on and identify their strengths as readers, areas for improvement, and the strategies they found most helpful before, during, and after reading
- developing and organizing content: generate, gather, and organize ideas and information to write for an intended purpose and audience
- using knowledge of form and style: draft and revise their writing, using a variety of literary, informational, and graphic forms and stylistic elements appropriate for the purpose and audience
- applying knowledge of conventions: use editing, proofreading, and publishing skills and strategies, and knowledge of language conventions, to correct errors, refine expression, and resent their work effectively
- reflecting on skills and strategies: reflect on and identify their strengths as writers, areas for improvement, and the strategies they found most helpful at different stages in the writing process
- understanding media texts: demonstrate an understanding of a variety of media texts
- understanding media forms, conventions, and techniques: identify some media forms and explain how the conventions and techniques associated with them are used to create meaning
- creating media texts: create a variety of media texts for different purposes and audiences, using appropriate forms, conventions, and techniques
- reflecting on skills and strategies: reflect on and identify their strengths as media interpreters and creators, areas for improvement, and the strategies they found most helpful in understanding and creating media text.

As well as this listing of required skills there are suggestions for teacher prompts. It is perhaps a reflection of the comparative autonomy of teachers that the programs of study should be specified in a level of detail that approaches that of a scheme of work. For example the active listening strategies component of a Grade 10 applied program states:

> identify and use a few different active listening strategies when participating in classroom interactions (e.g., use culturally appropriate body language and eye contact when participating in a discussion; take turns speaking and avoid

interrupting others during an informal debate; express interest in another student's presentation by commenting and asking questions afterwards).

This is detailed enough. But in addition there are suggested teacher prompts: "What strategies can you use to participate as a listener in a small group?" "How do you know when people are listening to you?"

Scope:
The programs of study are consistent through all grades:

- oral communication
- reading
- literature
- writing and media.

For Grades 9-12 optional courses are introduced.

The compulsory courses emphasize strong core competencies in listening, speaking, reading, writing, viewing, and representing. As part of their program in Grades 9 and 10, students must take one compulsory course in English in each grade. These courses are offered at two levels, academic and applied. The applied course represents a much less ambitious level of performance.

An optional course at Grade 10, *Literacy Skills: Reading and Writing*, offers students an opportunity to enhance their literacy skills. For Grade 11 optional courses include: workplace preparation, reading and literature studies, Canadian literature, media studies, presentation and speaking skills, and in Grade 12 studies in literature, the writer's craft, business and technological communication.

Levels of Demand:
For Grades 9 – 10 students are assigned to academic or applied courses, effectively banded. Academic courses are described as intended to develop students' knowledge and skills through the study of theory and abstract problems. These courses focus on the essential concepts of a subject and explore related concepts as well. They incorporate practical applications as appropriate.

Applied courses focus on the essential concepts of a subject, and develop students' knowledge and skills through practical applications and concrete examples. Familiar situations are used to illustrate ideas, and students are given more opportunities to experience hands-on applications of the concepts and theories they study.

The language is interesting, academic courses having "theory" and "abstract", applied having "practical applications" and "hands on." Thus a Grade 9 applied course asks students to "select complex media texts, identifying some of the overt and implied messages they convey" (for example, emotive language used in a newspaper headline signals a dramatic event; images of

happy families in television advertizing for fast-food restaurants link the product to ideas of family harmony and togetherness).

For the same age group in the academic band students are asked to interpret media texts, including increasingly complex texts, identifying and explaining the overt and implied messages they convey (for example, the use of talking animals as characters in a TV program or on a website often signals an intention to appeal to children; in a fashion feature, models' facial expressions and body language, as well as the setting and lighting of the photographs, create a mood or attitude that is associated with the fashions themselves). The depth of analysis in the academic stream is much greater, and, for Grade 9, challengingly sophisticated.

By Grade 12 this has become: "interpret media texts, including complex or challenging texts, identifying and explaining with increasing insight the overt and implied messages they convey" (for example, explain the satiric message in a newspaper cartoon about a social or political issue; explain the messages about Canadian culture in a television program about a Canadian topic; identify some underlying social and/or political messages in an animated TV sitcom and suggest possible reasons why the messages are implied rather than openly expressed). Teacher prompts: "How can you detect the particular bias of a blog if it is not overtly expressed?" "Why is it important to verify information found on websites?" "Why do you think the few women are featured so prominently in this photograph of a group of politicians?"

This merges well with the social dimension of language use. The level of expectation increases in a clearly articulated set of expectations. For example in Grade 9, making inferences on complex texts, students are expected to make basic connections between the ideas in them and personal knowledge, experience, and insights; other texts; and the world around them (for example, visually depict the main conflict in a story as if for a book dust jacket, using illustrations, photographs, or artifacts; use a T-chart or a Venn diagram to compare the experience of a character in a story to their own experience or the experience of a character in a different story; comment on the discussion of a teen issue, such as body image, in a magazine article, drawing on their own experience and understanding of the issue).

By Grade 12 (academic) this has become: make and explain inferences of increasing subtlety and insight about texts, including complex and challenging texts, supporting their explanations with well-chosen stated and implied ideas from the texts (for example, explain what the details in a story suggest about the author's attitude towards the subject; explain what made them begin to doubt the reliability of the narrator in a novel; identify and explain inferences that can be drawn from the home page of a website).

Both are challenging for the grade. The increasing sophistication is well articulated, moving from simple character delineation to a nuanced understanding of potential ambiguities and sub themes. However the applied level is not as limited as the title suggests. Grade 10 retains both complexity and abstraction. Again, much discretion is left to the teacher:

> Purpose and Audience:
> Explain how simple media texts and some teacher-selected complex media texts are created to suit particular purposes and audiences (for example, advertisements for games and toys use bright colors and happy images to appeal to children; horror movies use unusual camera angles, menacing music, and special effects to create a spooky atmosphere; a teen magazine uses teen insider jargon and an offbeat layout to appeal to its readers' desire to establish their own identity. Teacher prompt: "Why do fashion magazines contain many photographs and relatively little text?"

By Grade 12 academic, levels of expected performance are high. In listening, for example:

> Using Active Listening Strategies – understand and acknowledge a dissenting opinion in a small-group discussion. Teacher prompt: "When you disagree with the ideas of a classmate, how do you respectfully communicate your position?"

Lower grades are relatively classroom based, but by Grade 12 there is more interaction with wider communities:

> Generate, expand, explore, and focus ideas for potential writing tasks, using a variety of strategies and print, electronic, and other resources, as appropriate for example, record notes from a group discussion about a literary work to generate ideas for an analytical essay on the work; use a variety of strategies, including inquiry, divergent thinking, and discussion with peers, to explore a potential topic and generate ideas for writing an informational report; use a writer's notebook while reading literary texts to jot down and keep a record of ideas for creative writing; brainstorm to develop a focus for their research, formulate a question that encapsulates the focus, and establish their research parameters to suit the focus; consult print, electronic, and other resources, including public and postsecondary library collections, to identify potential sources of information for a report or essay; create and annotate a list of website addresses that may be useful in researching a topic; before starting their research, interview community business people, representatives of volunteer or community-service organizations, or social-issue advocates, as appropriate to their topic; record all sources used to gather ideas and information, so that if they use the ideas and information, they can credit the original author, avoid plagiarism, and provide a complete bibliography or reference list.

Progression:
In Grade 9 – 10 students are assigned to academic or applied bands. The academic band is described as preparing students for university or college, the applied as preparing students for college or workplace. At Grade 9 and Grade 12 there are specific literacy expectations, overseen by the EQAO. Typically tests represent 30% of final assessment of a course. Students must receive 50% or higher in a course to receive a credit for that course. To progress from

Grade 12 students must be deemed to have met the secondary school literacy requirement for graduation. This is tested by a specific examination set by the EQAO, the Ontario Secondary School Literacy Test (OSSLT), to be passed at Grade 10, together with four credits in English, one from each grade.

Assessment:
This is described in the Ministry publication *Growing Success: Assessment, evaluation and reporting in Ontario Schools,* which draws heavily on the formative assessment work of Black and Wiliam.

Assessment is largely teacher centered, drawing upon the very specific programs of study described above, but cross referenced to examinations administered by the provincial EQAO the independent government body that develops and oversees standardized tests for students in Grades 3, 6, 9 and 10. For Grades 9 to 12, a final grade, expressed as a percentage, is given for every course. The final grade constitutes:

- Seventy per cent for teacher led evaluation throughout the course. This is intended to evaluate the student's most consistent level of achievement throughout the course
- Thirty per cent based on a summative evaluation administered at the end of the course, based on one or a combination of: an examination, a performance, an essay, and/or another method of evaluation suitable to the course content.

The final evaluation allows the student an opportunity to demonstrate comprehensive achievement of the overall expectations for the course. Most exams are about 90 minutes in length and worth 15 to 20% of the final grade, but for the mother tongue, Grade 10 students must take the Ontario Secondary School Literacy Test, which measures whether or not they are meeting the minimum standard for literacy across all subjects up to the end of Grade 9, and for Grades 11 and 12. The test has three components: reading; writing; and understanding and assessing growth in literacy.

Key competencies:
Programs of study are very highly detailed. They are organized around oral communication, reading and literature, writing and media. Examinations are restricted to reading, writing and literacy.

Secondary: Mathematics

Orientation:
The mathematics curriculum sets out its main goals as preparing students for their future roles in a society that is technological, quantitatively-oriented and changing. It aims to equip them with "essential mathematical knowledge and skills; with skills of reasoning, problem solving, and communication; and, most importantly, with the ability and the incentive to continue learning on their own." Mathematics is characterized as a subject whose demands have changed in response to new technologies, new cross-disciplinary applications and problems.

The curriculum leads with an expression of a largely constructivist pedagogy: students learn mathematics effectively when they are initially given opportunities to investigate ideas and concepts and are then guided carefully into an understanding of the abstract mathematics involved. It highlights the role for teachers in providing opportunities for enquiry and focusing students on abstraction. Skill acquisition in context is also emphasized.

The Grade 9 and 10 curriculum has a particular aim to develop algebraic skills. In the earlier grades algebraic reasoning consisted largely of moving between algebraic expressions and context problems (that is, generating and interpreting expressions) and only informal skills of manipulating expressions or solving equations. Grade 9 begins a shift to more abstract skills in order to match the relevant grade content and to prepare for future study. This is particularly evident in the aims of the academic course (Principles of Mathematics) to study essential concepts, theory and abstract problems. The applied course (Foundations of Mathematics) stresses practical applications, concrete examples and hands-on learning. School boards may develop their own third course to meet the need for another work-related pathway.

Grades 11 and 12 have different aims depending on the pathway. For further study, there is an overall theme of characterizing functional relations in abstract and real-life situations. The workplace preparation pathway is instead aimed at solving numeric or graphical problems in contexts related to everyday citizenship (budgeting, chance and risk, spatial measures).
The curriculum document sets out the procedures by which the curriculum expectations may be modified or accommodated for exceptional students. There are no specific mathematical recommendations; instead these would be the focus of an individual education plan. It also identifies that some learners with English as a second language may need modified expectations or a more varied and visual range of instructional strategies. Teachers are encouraged to consider attitudes to mathematics, to incorporate anti-discriminatory materials and challenge gender-based constraints.

Coherence and Clarity:
The curriculum is presented as a set of expectations that relate to content, and a more limited set that relates to mathematical processes and applies across all content areas. Teachers and schools are expected to weave these together into integrated programs that balance "concept development, skill acquisition, the use of processes, and applications." These four areas overlap partially with the four categories that are generic to assessing achievement in all subjects:

- knowledge and understanding: subject-specific content, and comprehension of its meaning and significance
- thinking: use of critical and creative thinking skills/processes
- communication: conveying of meaning in various forms (written, oral, visual)
- application: use of knowledge and skills to make connections within/between different contexts.

It is notable in this curriculum that the majority of the content expectations include a specification of the approach to be taken (as in "determine through investigation, connections among the representations of a constant rate of change of a linear relation" Grade 9 applied). Investigation, problem solving and connection between representations are recurrent themes throughout Grades 9-12. In addition some content expectations are in themselves statements of problems, for example investigating optimal values of measurements is an important topic across Grade 9, or solving problems involving financial applications in Grade 11 functions. These features make it a particularly coherent curriculum in terms of relating content to the process skills and the overall curricular goals.

Within each grade and course's content expectations, the material is organized in strands and subdivided into overall and specific expectations. In Grades 9 and 10 some strands (such as number and algebra, linear equations) are common to both pathways, some are not. Strands do not run across grades but instead change and become more abstract (for example, linear relations becomes analytic geometry in Grade 10 academic pathway, but modeling linear relations in Grade 10 applied). One of the recurrent themes of the curriculum document is the importance of coherent progression between grades, especially where there is also a transition between schools (Grade 8 to 9, 10 to 11). The document sets out carefully how material within each strand builds on the previous grade and introduces new aspects. It also characterizes the differences between parallel courses at this same level of detail. There is mention of a transfer course and assessment from Grade 9 applied to Grade 10 academic.

There is enough detail in this curriculum to plan a program of work. The concern for teachers would be in knowing when to stop investigating/ solving problems and move on.

Scope:
The curriculum is set out by grade and by pathway (applied or academic) for lower secondary (Grade 9-10) and then divides into five pathways for Grades 10-12: university preparation, university/college preparation, college preparation, workplace preparation and open pathways.

Grades 9-10
The content for each of the pathways in Grades 9-10 includes around 50 expectations for each grade, set out in three or four strands as follows:

Strands by grade and pathway	**Grade 9**	**Grade 10**
Applied	Number Sense and Algebra Linear Relations Measurement and Geometry	Measurement and Trigonometry Modeling Linear Relations Quadratic Relations of the Form $y = ax^2 + bx + c$
Academic	Number Sense and Algebra Linear Relations Measurement and Geometry Analytic Geometry	Quadratic Relations of the Form $y = ax^2 + bx + c$ Trigonometry Analytic Geometry

The noticeable characteristic of the content is the centrality of linear relations, which is explored in depth, with a full range of connections. Tabular treatments, scatter graphs, line of best fit are all included in linear relations, alongside the graphical and algebraic identification and representation of linear and non-linear relations. Hence there is no separate handling data strand (and no probability in these grades). The number strand in Grade 9 applied course focuses on proportional reasoning and solving linear equations, again reinforcing the linear relations strand. In Grade 10, the academic course moves on to a similar graphical and algebraic treatment of quadratic graphs (having already covered relevant algebraic manipulation, and physical representation of exponential quantities). The applied course continues with modeling linear relations using algebraic and graphical representations.

This connected in-depth treatment of topics in one or two grades is a feature of this curriculum. It can be seen in Grade 8 where determining the area of a circle is accompanied by finding formulae for volume and surface area of cylinders. Similarly in Grade 10 academic students move from trigonometric ratios for right-angled triangles to the sine and cosine rule for all acute-angled triangles. There is no built-in expectation that new concepts and skills need time to be consolidated before they are used in another context.

The geometry curriculum in these grades is noticeably non-Euclidean, with an emphasis on measures. As described above the inclusion of problems of optimizing perimeters, areas and other measures on planar shapes adds a problem solving, pre-calculus dimension to these grades. Formal theorems such as the angles between parallel lines and a transversal, or similarity are treated via investigation, verification and application rather than a context for proof. Proof and proving do not appear in Grades 9 and 10.

The focus on linear and quadratic relations in these two grades is similar to that of the Japanese curriculum (and one grade later). Here, however, there is more curricular detail about investigation, multiple representations and problem solving activities. To balance this, the geometry curriculum at these grades is narrower and less proof-based than the Japanese one.

Grades 11-12

The courses in these grades follow sequences depending on intentions for future study. As in the earlier grades there is an explicit discussion of the progression within each pathway. Only one of these courses is necessary for a diploma (assuming two credits were obtained in Grades 9 and 10). Each course consists of over 50 stated expectations, often closely linked so adding depth and interconnections, and each with an example problem or activity.

The strands covered are as follows:

University Preparation courses:

These are further separated into one branch (lowermost in the diagram) that includes the study of probability and statistics in preparation for social sciences programs, and a second branch that includes exponential and logarithmic functions (preparation for business, health and social sciences) and could continue to calculus work needed for further STEM study.

	Grade 11		Grade 12
	Functions		**Advanced functions**
A	Characteristics of functions	A	Exponential and logarithmic functions
B	Exponential functions	B	Trigonometric functions
C	Discrete functions	C	Polynomial and rational functions
D	Trigonometric functions	D	Characteristics of functions
			Calculus and Vectors
		A	Rate of change
		B	Derivatives and their applications
		C	Geometry and Algebra of vectors
			Mathematics of Data
		A	Counting and probability
		B	Probability distributions
		C	Organization of data for analysis
		D	Statistical analysis
		E	Culminating data management investigation

The scope of this final pathway is impressive in both breadth and depth including differentiation algebraically, from first principles and graphically for polynomials, exponential and trigonometric functions, extending to problems in context. There is also a substantial treatment of vector equations for the plan including vector and scalar product. Integration is not treated (either as anti-differentiation or as area).

University/College and College Preparation courses:
Again there are two branches in this pathway, aimed broadly for those who intend to work in technology, so need to solve problems analytically using precise algebraic and graphical representations of functions in an applied context, and for those who do not, where the course introduces exponential growth and decay in a range of context problems that can be solved by numeric and graphical methods including the use of technology. Each of these courses can be accessed from either the academic or applied strand in Grade 10. The technological course is designed to give students access to the university preparation Grade 12 course *Advanced Functions* (presumably by repeating a year). Some of the examples come from specialized scientific contexts but require non-specialist interpretation (for example, the forces acting on a horizontal ceiling beam cause it to take a shape given by a polynomial function, Grade 12).

	Grade 11		Grade 12
	Functions and Applications		**Mathematics for College Technology**
A	Quadratic functions	A	Exponential functions
B	Exponential functions	B	Polynomial functions
C	Trigonometric functions	C	Trigonometric functions

	Foundations for College Mathematics		**Foundations for College Mathematics**
A	Mathematical models	A	Mathematical models
B	Personal finance	B	Personal Finance
C	Geometry and Trigonometry	C	Geometry and Trigonometry
D	Data Management	D	Data Management

Workplace preparation courses:
These courses have an emphasis on gathering and interpreting information about quantitative aspects of budgeting, taxation, borrowing and saving, purchasing and travel. They have a citizenship and entrepreneurial purpose without involving algebraic reasoning. They revisit of mathematics from previous grades, such as probability, proportional reasoning, finding areas. There is no trigonometry in this pathway. The examples given tend to use contexts that are domestic, personal or general knowledge (for example, interpret population statistics given in the media); workplace contexts are simplistic/contrived (for example, what is the floor area needed to show three cars in a car showroom).

	Grade 11		**Grade 12**
	Mathematics for Work and Everyday Life		**Mathematics for Work and Everyday Life**
A	Earning and purchasing	A	Reasoning with data
B	Saving, investing and borrowing	B	Personal Finance
C	Transportation and travel	C	Applications of measurement

Levels of Demand:
The level of demand in this curriculum is high in terms of problem solving and applying new mathematics to model a range of contextual and abstract situations. The Grade 9 state tests support this mathematical literacy by requiring students to understand a range of mathematics-related texts and diagrams. The two pathways at Grades 9 and 10 establish different standards for algebraic manipulation, and the pathways at Grades 11 and 12 continue this distinction and also restrict the kinds of relations met and the approaches taken (numeric or graphical verses analytic). Demand and progression are maintained in the more restricted pathways by increasing the range of contexts and the use of secondary data.
Algebraic manipulation is introduced a little later than standard, but is developed quickly in the academic Grade 10. In the earlier grades demand is maintained by generating and interpreting expressions in a very wide range of contexts. There is no specification in the curriculum about when students should start to meet extended and unfamiliar algebraic reasoning problems, such as transformations of trigonometric identities. The algebraic example problems tend to be routine (but not simple) conversions such as between factorized, polynomial and completed square forms of quadratics.

Overall the pathways show a sound increase in demand year on year. The most advanced pathway offers an in-depth study of rates of change, including early calculus, all in Grade 12 and alongside the *Advanced Functions* course so is particularly demanding but also appropriate for its purpose.

The inclusion of exponential growth and decay for the technological as well as the university pathways is a good foundation for future study for much of the population. There is less demand for geometric proof than in many traditional curricula, and this extends only to Grade 10.

Progression:
There is coherent progression in the content expectations, but revisiting over time is not included *per se*. As stated above the curriculum tends to group related topics together, developing a new concept quickly into other areas within one or two grades. This means that some topics such as probability and sequences are put to one side for long periods. This is not necessarily problematic. In the later grades there is more continuity, for example in the overall strand of functions, except for the most advanced pathway where students continue to meet new concepts.

The processes expectations are the same for each grade and pathway at Grade 9 and 10 (and the same as they were at Grade 8). There is minimal progression in the examples offered: at Grade 9 reasoning includes recognizing relationships and inductive reasoning, while by Grade 12 it also includes deductive reasoning. However, unlike many curricula, processes are often explicit in the content and there is an increase in complexity.
Assessment:
The only provincial mathematics test for secondary school is at Grade 9. There are versions for the applied and academic pathways and they match the expectations well. In particular they explore the meaning of mathematical features in models of real-life linear situations. Many questions require multiple choice answers with well-devised distractors that diagnose known misconceptions. Open response questions included justification of geometric properties related to angles and polygons. In keeping with the delaying of algebraic manipulation until Grade 9 there were no open response questions that demanded algebraic manipulation.

All courses are assessed internally; with 50% score needed for credit towards the high school diploma. Seventy per cent of the grade is based on evaluations conducted throughout the course, reflecting the student's most consistent and recent levels of achievement throughout the course. Thirty per cent of the grade is based on a final evaluation. There are performance standards assessed at four levels and with associated % ranges. The categories and levels are generic for all subjects although a few examples are given for mathematics. These standards require teachers to interpret of what constitutes limited/some/considerable and thorough understanding of concepts and effectiveness of thinking, communication and application. Considerable moderation or use of prior knowledge of standards between teachers and schools would be needed to ensure exactly comparable assessment design and marking.

Key competencies:
The seven mathematical processes identified in this curriculum are problem solving, reasoning and proving, reflecting, selecting tools and computational strategies, connecting, representing, and communicating. They are well developed throughout the curriculum because they are integrated into the content expectations.

Problem solving, representing and connecting seem to have a particular emphasis. Although the curriculum as a whole is traditional, there is extensive reference to using technology to learn mathematics and this increases in the later grades. This includes graphing software, spreadsheets, calculators with equation solving features, design, drawing and dynamic geometry software.

Secondary Science

This section concentrates on the common elements across the secondary science curriculum. Individual sections on Earth science, biology, chemistry and physics follow.

The vision and aims of the science curriculum have strong educational purpose, and have been carefully thought through. There is coherence across the curriculum documents, so that stated aims, goals and introduction, marry up and are supported by later material, detailing content, suggested teaching approaches and assessment, for example.

The orientation leans toward education for improving future society – sustainability and the interaction of people and environment is a strong thread. The flourishing of the individual is also part of the educational rationale for the curriculum, for example, revealed in the statement that students should develop a "high degree of scientific literacy while maintaining a sense of wonder about the world around them." The curriculum has good balance between educational purposes, and draws on strong philosophical perspectives of education.

Science education in Ontario is defined by three key documents:

- the Ontario Curriculum, Grades 1–8: Science and Technology, 2007
- the Ontario Curriculum, Grades 9 and 10: Science, 2008
- the Ontario Curriculum, Grades 11 and 12: Science, 2008

The goals for all Ontario science programs are stated as:

- to relate science to technology, society, and the environment
- to develop the skills, strategies, and habits of mind required for scientific inquiry
- to understand the basic concepts of science

The overall aim of the secondary science program is to ensure scientific literacy for every secondary school graduate. To better achieve this aim, all courses in the program are designed

to focus on science not only as an intellectual pursuit but also as an activity-based enterprise within a social context.

The science courses in the Grade 9 and 10 curriculum are offered in two course types: academic and applied. The expectations in all Grade 9 and 10 courses are organized in five strands, the first focusing on scientific investigation skills and the remaining four representing the major content areas in the science curriculum. The five strands are as follows:

a) scientific investigation skills and career exploration
b) biology
c) chemistry
d) Earth and space science
e) physics

The expectations for the Grade 11 and 12 science courses are organized in six distinct but related strands. The first strand (strand A) focuses on scientific investigation skills, which are similar for all courses; the remaining five strands (strands B through F) represent the major content areas for each course. The content for each course includes, where possible, topics set out in the pan-Canadian *Common Framework of Science Learning Outcomes* (CMEC, 1997).

Strand A in both programs outlines required learning related to scientific investigation skills (SIS). The expectations in this strand describe the skills that are considered to be essential for all types of scientific investigation. These skills apply to all areas of course content and must be developed in conjunction with learning in all content strands of the course.

The scientific investigation skills are organized under subheadings related to the four broad areas of investigation – initiating and planning; performing and recording; analyzing and interpreting; and communicating. The documents state that teachers should ensure that students develop the scientific investigation skills in appropriate ways as they work to achieve the curriculum expectations in the content strands. It is stated that students' mastery of these skills must be assessed and evaluated as part of students' achievement of the overall expectations for the course.

Coherence and clarity:
The Ontario Curriculum, Grades 1 to 12, outlines the knowledge and skills required for the different programs. Each curriculum document provides a broad overview linking to prior learning and the overall outcomes. The Ontario Curriculum, Grades 9 and 10: Science, 2008 identifies the curriculum expectations for both the academic and applied courses.

Two sets of expectations – overall expectations and specific expectations – are listed for each strand, or broad area of the curriculum (The strands are numbered a), b), c), d) and e.) Taken together, the overall expectations and specific expectations represent the mandated curriculum.

Levels of demand:

The Ontario Curriculum, Grades 1–8: Science and Technology, 2007, provides a map to show the sequence of topics from Grade 1 through to the Grade 10 academic and applied courses in science and technology. This same theme is repeated in the Grades 9 and 10, and Grades 11 and 12 documents.

Mapping is also provided for Grades 1 to 8 showing the skill continua for:

- scientific inquiry/experimentation skills
- scientific inquiry/research skills
- technological problem-solving skills

Which do follow through to Grades 9 – 12 but in a different format.

The format shows the interactions of the skill areas, since they are not necessarily followed in a sequential way. These clearly show the level of demand as a continuum: Beginning – Exploring – Emerging – Competent – Proficient.

The level of demand in the content is also clearly defined, from Strand to Big Idea to general outcomes and finally specific outcomes. These are designed to be accessible, and at grade 11 and 12, to the appropriate pathway chosen by the student, which may be college preparation, university preparation, university / college preparation, or workplace preparation.

Demand and Progression:
There are a number of features of the documentation which indicate demand and show progression. Levels of demand are clearly set out and tabulated to show progression, for example in skills of scientific investigation such as analyzing and interpreting, through a continuum of achievement: Beginning – Exploring – Emerging – Competent – Proficient. The way that the content is presented, from Strand to Big Idea to General Expectations, Specific Expectations, Sample issues and Sample Questions helps to clarify the level of demand, and also aids an overview of progression through the curriculum.

The different pathway available to students place distinctive demands on the dependent on their pathway to university, college or the workplace. Furthermore, prerequisite charts show the progression by course through these differing pathways. It may be difficult to move between pathways but these charts at least provide explicit statements of the requirements necessary for movement.

Assessment:
The *Ontario Curriculum, Grades 9 and 10: Science, 2008* and *Ontario Curriculum, Grades 11 and 12: Science, 2008* provide a clear framework for the assessment of student performance.

They state:

> Assessment is the process of gathering information from a variety of sources (including assignments, day-to-day observations, conversations or conferences, demonstrations, projects, performances, and tests) that accurately reflects how well a student is achieving the curriculum expectations in a course. As part of assessment, teachers provide students with descriptive feedback that guides their efforts towards improvement. Evaluation refers to the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality.

Assessment and evaluation is based on the provincial curriculum expectations and the achievement levels outlined in these documents.

The evaluation of student performance focuses on students' achievement of the overall expectations. A student's achievement of the overall expectations is evaluated on the basis of his or her achievement of related specific expectations. Teachers use their professional judgment to determine which specific expectations should be used to evaluate achievement of the overall expectations, and which ones will be covered in instruction and assessment but not necessarily evaluated.

As with other subjects, the teacher assesses student performance to produce a level of achievement. There are four levels of achievement:

- level 1 identifies achievement that falls much below the provincial standard, while still reflecting a passing grade
- level 2 identifies achievement that approaches the standard
- level 3 is the standard
- level 4 identifies achievement that surpasses the standard.

Achievement at level 4 does not mean that the student has achieved expectations beyond those specified for a particular course. It indicates that the student has achieved all or almost all of the expectations for that course, and that he or she demonstrates the ability to use the knowledge and skills specified for that course in more sophisticated ways than a student achieving at level 3.

To enable teachers to make these judgments an achievement chart that identifies four categories of knowledge and skills in science is provided. The achievement chart is a standard province-wide guide to be used by teachers. It enables teachers to make judgments about student work that are based on clear performance standards and on a body of evidence collected over time.

The achievement chart provides the following criteria:

- categories of knowledge and skills:
    - knowledge and understanding
    - thinking and investigation

- communication
- application.

Within each category in the achievement chart, criteria are provided that are subsets of the knowledge and skills that define each category, for example, knowledge and understanding:

- knowledge of content (for example, facts, terminology, definitions, safe use of equipment and materials)
- understanding of content (for example., concepts, ideas, theories, principles, procedures, processes).

Descriptors indicate the characteristic of the student's performance, with respect to a particular criterion, on which assessment or evaluation is focused.

In the achievement chart, effectiveness is the descriptor used for each criterion in the thinking and investigation, communication, and application categories, for example, in the thinking and investigation category, assessment of effectiveness might focus on the degree of relevance or depth apparent in an analysis.

A qualifier is used along with a descriptor to produce a description of performance at a particular level. For example, the description of a student's performance at level 3 with respect to the first criterion in the thinking and investigation category would be: "The student uses initiating and planning skills and strategies with considerable effectiveness."

It is clear that the assessment arrangements align tightly with the curriculum and that the four levels of achievement provide sufficient coverage of the curriculum.

As in other subjects, the final grade is recorded for every course, and a credit is granted and recorded for every course in which the student's grade is 50% or higher. The final grade for each course is determined as follows:

- 70% of the grade will be based on evaluations conducted throughout the course. This portion of the grade should reflect the student's most consistent level of achievement throughout the course, although special consideration should be given to more recent evidence of achievement
- 30% of the grade will be based on a final evaluation in the form of an examination, performance, essay, and/or other method of evaluation suitable to the course content and administered towards the end of the course.

Key competencies:
The *Ontario Curriculum, Grades 9 and 10: Science, 2008* and the *Ontario Curriculum, Grades 11 and 12: Science, 2008* both describe critical thinking and critical literacy in science (they are identical in this respect). They state:

> Critical thinking is the process of thinking about ideas or situations in order to understand them fully, identify their implications, and / or make a judgement about what is sensible or reasonable to believe or do. Critical thinking includes skills such as questioning, predicting, hypothesizing, analyzing, synthesizing, examining opinions, identifying values and issues, detecting bias, and distinguishing between alternatives.
>
> Critical literacy is the capacity for a particular type of critical thinking that involves looking beyond the literal meaning of a text to determine what is present and what is missing, in order to analyze and evaluate the text's complete meaning and the author's intent. Critical literacy goes beyond conventional critical thinking by focusing on issues related to fairness, equity, and social justice. Critically literate students adopt a critical stance, asking what view of the world the text advances and whether they find this view acceptable.

The documents make it clear that these two competencies should be developed as they develop their skills in scientific investigation skills.

Other required competencies are: works independently; teamwork; organization; work habits; and initiative. These are evaluated and reported using a four-point scale: excellent; good; satisfactory; needs improvement.

Secondary: Earth Science

Orientation:
The stated goals of earth and environmental science are:

- to relate science to technology, society, and the environment
- to develop the skills, strategies, and habits of mind required for scientific inquiry
- to understand the basic concepts of science.

These reveal three strong themes which recur through the curriculum of application (of earth science to real world contexts and issues) skills and concepts (such as place, system and human-environment, which are helpfully expressed as "big ideas."

There are some interesting strengths to the orientation of the curriculum. Education is seen as a partnership with roles and responsibilities of students, teachers, parents and community. Antidiscrimination education is a theme as is critical thinking and critical literacy.

Coherence and Clarity:
Earth science is woven into wider science, and environmental science. There is strong coherence in the unifying theme of the natural world. The lens of human-nature interaction with nature is used to position earth science, but there is always attention to how scientific principles can be applied to studying nature and people. The curriculum is set out in such a way that

strands can be easily followed, and so the location of content, skills and values within those strands, makes sense. The relevant strands here are Earth and space science.

The big ideas of place, system and human-environment are developed coherently through the curriculum. There is also strength in the consideration of matters that have bearing on curriculum, including pedagogy (advice given to teachers, such as for differentiation and SEN) and the role of assessment.

Scope:
The coverage of earth science is broad and deep, when taken across both the lower and upper phases of secondary education. All main systems that affect the surface of the earth (rivers, coasts, weather, tectonics, ecosystem) are present. There is particular emphasis on some areas including ecosystems and climate change. The systems and people-environment emphases are clear from the following content areas of the curriculum:

- the earth's physical and biological systems
- the dependency of our social and economic systems on these natural systems
- the scientific and human dimensions of environmental issues
- the positive and negative consequences, both intended and unintended, of the interactions between human-created and natural systems.

The curriculum takes an issues approach, with the use of current and local concerns, enlivening and giving context to the study of the key concepts and development of skills. A "sample issue" helps guide teachers, without being overly prescriptive. Some notable strengths in curriculum scope, which draw on skills and attitudes as well as knowledge content, include environmental education and sustainability and attention to the roles of ICT, experiential learning (including fieldwork), cooperative learning, critical thinking, citizenship, and personal responsibility.

Levels of Demand:
The demand and potential to stretch and challenge all students is high. The conceptual, skills, contextual (place and time) and issues-based elements of the curriculum all support appropriate demand. There is breadth and depth in the coverage of earth science and the assessment arrangements allow for local (teacher) design for appropriately demanding assessment. Formative assessment is a feature and should also support challenge for students. Another notable strength is attention to SEN and bilingual students, and guidance for differentiating the curriculum.

Progression:
There is clarity and coherence across the earth and environmental science curriculum, both within and between grades and phases of secondary education. There are elements of a strong spiral curriculum, with big ideas and concepts revisited and deepened, through the curriculum design. Progression has been thought through and the detail of content and skills relates to a bigger picture of Earth science education. A strong feature is the four level progression of

conceptual understanding, which guides teachers in their expectations and aims of "awareness – emergence – refinement – extension."

Assessment:
There is a rationale for the use of assessment that goes beyond summative purposes. Formative uses of assessment are emphasized in the opening statement of assessment section of the curriculum. "The primary purpose of assessment and evaluation is to improve student learning." Detailed descriptors and qualifiers are used to support rigorous assessment against each learning objective. Qualifiers relate to "limited – some – considerable – high" levels. The four key areas of learning outcome (knowledge and understanding/thinking and investigation/communication/ application) are covered in detail in assessment schedules. A strong feature is the use of a report card system to give all students clarity on their achievement and to support equal access to the curriculum. 70% of assessment is expected to be on course evaluation and 30% final examination. These assessments are flexible in mode – for example they can be essay or short answer as most appropriate locally. Fieldwork is mentioned in the curriculum and there is some scope for assessment of practical work or enquiry, although this is not exemplified in detail. Overall, assessment ties in with progression and overall aims, thus supporting curriculum coherence.

Secondary: Biology

Coherence and Clarity:
There is biological content in the science program of study for the Grade 9 and 10 courses, described in strand B. Biology.

The illustrations are from the academic program. The applied program is very similar, but more context driven.

- Grade 9: sustainable ecosystems
- Grade 10: tissues, organs, and systems of living things

Each has overall "Big Ideas":

Grade 9 Biology:
- ecosystems are dynamic and have the ability to respond to change, within limits, while maintaining their ecological balance
- people have the responsibility to regulate their impact on the sustainability of ecosystems in order to preserve them for future generations

Grade 10 Biology:
- plants and animals, including humans, are made of specialized cells, tissues, and organs that are organized into systems

- developments in medicine and medical technology can have social and ethical implications.

The content is described at two levels – overall expectations and specific expectations. For Grade 9 there are three overall expectations:

- B1 assess the impact of human activities on the sustainability of terrestrial and / or aquatic ecosystems, and evaluate the effectiveness of courses of action intended to remedy or mitigate negative impacts
- B2 investigate factors related to human activity that affect terrestrial and aquatic ecosystems, and explain how they affect the sustainability of these ecosystems
- B3 demonstrate an understanding of the dynamic nature of ecosystems, particularly in terms of ecological balance and the impact of human activity on the sustainability of terrestrial and aquatic ecosystems.

An example of a specific expectation from B1; by the end of this course, students will:

> B1.1 assess, on the basis of research, the impact of a factor related to human activity (e.g., urban sprawl, introduction of invasive species, overhunting/overfishing) that threatens the sustainability of a terrestrial or aquatic ecosystem.

The first specific expectation for each strand is enhanced with a sample issue and sample questions that can be together used to provide a context.

The Ontario Curriculum, Grades 11 and 12: Science, 2008 identifies the curriculum expectations for the five types of Grades 11 and 12 courses. The biology curriculum expectations are defined in Strand B – E of the biology programs, with strand A focusing on scientific investigation skills. So, for the Grade 11, university course:

- strand B: diversity of living things
- strand C: evolution
- strand D: genetic processes
- strand E: animals: structure and function
- strand F: plants: anatomy, growth, and function.

As with Grades 9 and 10, each has overall Big Ideas, for example, diversity of living things:

- all living things can be classified according to their anatomical and physiological characteristics
- human activities affect the diversity of living things in ecosystems.

The content is described at two levels – overall expectations and specific expectations, for example, for Strand B there are three overall expectations:

Diversity of living things:

- B1. analyze the effects of various human activities on the diversity of living things
- B2. investigate, through laboratory and/or field activities or through simulations, the principles of scientific classification, using appropriate sampling and classification techniques
- B3. demonstrate an understanding of the diversity of living organisms in terms of the principles of taxonomy and phylogeny.

An example of a specific expectation from B1, by the end of this course, students will:

> B1.1 analyze some of the risks and benefits of human intervention (for example, tree plantations; monoculture of livestock or agricultural crops; overharvesting of wild plants for medicinal purposes; using pesticides to control pests; suppression of wild fires) to the biodiversity of aquatic or terrestrial ecosystems.

Each specific expectation is enhanced with a sample issue and sample questions that can be together used to provide a context, for example:

> B1.1 sample issue: stocking lakes with fish provides recreation for fishing enthusiasts and increases the amount of food available for humans and other animals. However, this practice also increases the competition for food, which could threaten native species and affect the natural biodiversity of the aquatic ecosystem.
>
> B1.1 Sample questions:
>
> - how has suburban development on the Niagara Escarpment or the Oak Ridges Moraine affected local ecosystems?
> - how has the zebra mussel population in Lake Erie affected aquatic species and water quality?
> - how has commercial logging affected the sustainability of forests in Northern Ontario?

Strand A through Grades 9 – 12 deals with scientific investigation skills and career exploration, and has the same pattern of overall expectations and specific expectations as the content, for example, initiating and planning:

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

Together, these components provide clear guidance to teachers as to how the different requirements should be incorporated into the learning and teaching environment at a level that is appropriate to that grade.

Scope:
The science courses all follow the same basic pattern in the program of study documents, from Kindergarten – Grade 12, which makes them easy to follow.

The primary focus is the development of the required skills defined by Strand A in each of the three program of study documents. Strand A consists of Scientific Investigation Skills and Career Exploration.

The remaining strands pertain to content, and give a clear definition of the breadth, for example, Grade10 B3 Understanding Basic Concepts:

- B3.1 compare and contrast biotic and abiotic characteristics of sustainable and unsustainable terrestrial and aquatic ecosystems
- B3.2 describe the complementary processes of cellular respiration and photosynthesis with respect to the flow of energy and the cycling of matter within ecosystems (i.e., carbon dioxide is a by-product of cellular respiration and is used for photosynthesis, which produces oxygen needed for cellular respiration), and explain how human activities can disrupt the balance achieved by these processes (for example, automobile use increases the amount of carbon dioxide in the atmosphere; planting more trees decreases the amount of carbon dioxide in the atmosphere)
- B3.3 describe the limiting factors of ecosystems (for example, nutrients, space, water, energy, predators), and explain how these factors affect the carrying capacity of an ecosystem (for example, the effect of an increase in the moose population on the wolf population in the same ecosystem).

Each specific expectation is prefaced by a command word. At Grades 9 and 10, these are generally: describe, compare and contrast, and investigate. Explain is occasionally used. At Grades 11 and 12 these are describe, analyze, evaluate, and explain, suggesting a greater degree of depth is required.

For example, at Grade 11 and 12:

> D3.3 explain the concepts of genotype, phenotype, dominance, incomplete dominance, codominance, recessiveness, and sex linkage according to Mendelian laws of inheritance.

This indicates that students should have a sufficient depth of understanding to be able to explain these quite complex abstract concepts. Looking at the range of general and specific outcomes, and the learning outcomes described in them, there is a good balance of breadth and depth, appropriate these courses.

Levels of Demand:
The level of demand is appropriate for this course in biology. This is illustrated by the way each topic builds on from previous grades.

Progression:
The Ontario Curriculum, Grades 9 and 10: Science, 2008 states that the content of the Grade 7 and 8 program creates a strong foundation for students entering secondary school science programs. The transition from Grade 8 to Grade 9 is a smooth one because the content strands of the elementary science and technology program are closely aligned with those of the Grade 9 and 10 science program. So *Understanding Life Systems* from Grade 7 and 8 form a progression to biology in Grade 9 and 10.

Similarly, the senior science courses build on the Grade 9 and 10 science program, incorporating the same goals of science and fundamental concepts on which that program was based. The Grade 10 academic and applied courses prepare students for particular destination-related courses in Grade 11, for which prerequisites are specified in the Grade 11 and 12 curriculum policy document.

A similar progression exists from Grade 1 – Grade 12 for scientific inquiry / experimentation skills; scientific inquiry / research skills and technological problem-solving skills.

Assessment:
There are no formal provincial biology examinations in Ontario. See the assessment section of secondary science for more detail on formative assessment and teacher assessment.

Secondary: Chemistry

Orientation:
This report focuses on Grades 9-12, which comprises academic and applied routes in Grades 9-10 and further differentiated routes in Grades 11-12, leading to university/college entrance or the labor market.

Coherence and Clarity:
The documentation for the three stages is extensive and clearly laid out to show the range of routes as they become more diverse. This includes prerequisite studies. For example, the Grade 11 chemistry university preparation course requires Grade 10 science, academic. An overview of the topics through Grades 1-8 and Grades 9-10 provides a coherent view of the whole compulsory curriculum. There are similar tables for Grades 11-12.

The coherence of the content is facilitated by descriptions for each of the sciences of fundamental concepts for Grades 9-10 and Grades 11-12. For chemistry in Grades 9-10, these are: matter [but note, not for physics], structure and function, and sustainability and stewardship

[the latter for biology too but not for physics]). For Grades 11-12, energy, change and continuity is introduced as a fundamental concept in chemistry. The coherence is also facilitated by two or three big ideas for each of the sciences. For chemistry, one of two big ideas for Grade 9 is:

> The use of elements and compounds has both positive and negative effects on society and the environment.

The big ideas for subsequent year groups build on those for prior year groups and divide between academic and applied routes in Grade 10. Thus science, academic Grade 10 chemistry emphasizes environmental challenges and applied Grade 10 chemistry emphasizes applications in the home and workplace.

The overall expectations and specific expectations with sample issues and sample questions for chemistry are generally clear and coherent. For example, for Grade 9 science, academic, chemistry, one of three overall expectations is that students will "investigate through inquiry the physical and chemical properties of common elements and compounds." One of two specific expectations relating to science, technology, society, and the environment is that students "assess social, environmental and economic impacts of the use of common elements or compounds." One of five specific expectations relating to skills of investigation and communications is that students "conduct an inquiry to identify the physical and chemical properties of elements and compounds s (for example, magnesium sulfate, water, carbon, copper II). Finally, one of eight specific expectations relating to understanding basic concepts is that students "compare and contrast the physical properties of elements within a group (for example, alkali metals) and between groups (for example, the carbon group and noble gases) in the periodic table."

Scope:
The chemistry topics for Grade 9 are atoms, elements, and compounds for the academic route and exploring matter for the applied route and for Grade 10, chemical reactions with, for the applied route, their practical applications. The chemistry topics for Grades 11-12 in both university and college routes relate to organic chemistry and to electrochemistry, the topics for the university route are structure and the properties of matter, energy changes and rates of reaction, and chemical systems and equilibrium and the topics for the college route are matter and qualitative analysis, chemical calculations, and chemistry in the environment. While Grade 9-10 content is limited in breadth but treated in depth, the content for Grade 11-12 is not only treated in depth but also broad. The different routes provide an explicit basis for differentiation by student attainment, interest and career path.

Assessment:
There are no formal provincial chemistry examinations in Ontario. See the assessment section above under secondary science for formative and teacher assessment of science.

Secondary: Physics

Orientation:
The Ontario science curriculum is set out in three stages: Science and Technology Grades 1-8, Science Grades 9-10 and Physics (and other separate science) Grades 11-12. There is a common course up to Grade 8 in elementary schools. This is in distinction to secondary schools, so this review will generally consider Grade 9-12. There are academic and applied routes in physics Grade 9-10, and at Grade11-12 there are further differentiated physics routes leading to university or college entrance or for work preparation.

Coherence and Clarity:
The documentation for the three stages is extensive and clearly laid out to show the range of routes as they become more diverse. This includes prerequisite studies. For example the Grade 11 physics university preparation course requires Grade10 science, academic. An overview of the topics through Grade1-8 and Grade 9-10 provides a coherent view of the whole compulsory curriculum. There are similar tables for Grade 11-12. Coherence in the content is facilitated by descriptions of fundamental concepts (including matter and energy) and big ideas, for example physics Grade 9 includes:

> The production and consumption of electrical energy has social, economic, and environmental implications.

Experimentation / inquiry skills are presented as a continuum for a range of strands for example analyzing and interpreting develops from: "describes what was done and what was observed" to "evaluates the experimental procedure, explains changes that could be made to improve it, and gives reasons for the changes."

Scope:
Each course content is divided into strands with Strand A consisting of scientific investigation skills and career exploration. The remaining strands cover science content. The physics topics for Grade 9 are both electrical: electrical applications for the applied route and the characteristics of electricity for the academic.

The statements give a clear definition of the depth, for example, for the academic – overall expectation E2: investigate, through inquiry, various aspects of electricity, including the properties of static and current electricity, and the quantitative relationships between potential difference, current, and resistance in electrical circuits; specific expectation E2.7: investigate the quantitative relationships between current, potential difference and resistance in a simple series circuit.

And for the applied – overall expectation E2: investigate, through inquiry, the properties of static and current electricity and the cost of the consumption of electrical energy; specific expectation E2.7: calculate the costs of running common household electrical devices, and compare their efficiency.

The Grade 10 physics topic is light and optics with a similar theory / applications distinction between the two courses. Mechanics features in the elementary years, but this Grade 9-10

curriculum does appear rather limited in its range, although the topic coverage is thorough.

For Grade 11-12 there are five courses including physics content: a university physics route for Grade 11 and Grade 12, a college physics course for Grade 12, and Grade 12 science courses for university/college and for workplace. The university route has a thorough coverage of the subject with a strong emphasis on forces and energy, but also including wave theory, fields, electromagnetism and "modern physics" – quantum mechanics and special relativity. This last topic includes the big idea: new theories can change scientific thought and lead to the development of new technologies. The college physics course includes rather less theory but has a focus on applications related to mechanics, electromagnetism, energy transformations and hydraulic and pneumatic systems, with a big idea in the last topic of: the uses of hydraulic and pneumatic systems can have social and economic consequences. The Grade12 workplace science course physics content is the unit electricity at home and work, with a big idea: electrical equipment can pose a safety hazard in the home and workplace if it is not used correctly.
The overall content of the curriculum Grade 1– Grade 12 is broad and comprehensive in scope, with the alternative routes providing distinctive options within the subject.

Assessment:
There are no formal provincial physics examinations in Ontario. See the section on assessment in secondary science for more general science assessment expectations.

Social Studies[6]

Orientation
The program for social studies, history and geography Grades 1-8 is set out in a 200+ page document. The document appears to be conscious of some fundamental tensions between the integrative impulse of social studies and what it refers to a "disciplinary thinking." Impressive though the document is in many ways this tension remains unresolved, sitting beneath the explicit and elaborate goal to serve citizenship education, identity and inclusion. The following sets the scene within the vision and goals for social studies, Grades 1 to 6; history and geography, Grades 7 and 8; and Canadian and world studies, Grades 9 to 12.

- vision: the social studies, history, geography and Canadian and world studies programs will enable students to become responsible, active citizens within the diverse communities to which they belong. As well as becoming critically thoughtful and informed citizens who value an inclusive society, students will have the skills they need to solve problems and communicate ideas and decisions about significant developments, events, and issues

- goals: in social studies, history, and geography and all the subjects in Canadian and world studies, students realize the vision for the program as they:

[6] History and geography can be taught separately in Grades 7 and 8.

- develop the ability to use the "concepts of disciplinary thinking" to investigate issues, events, and developments
- develop the ability to determine and apply appropriate criteria to evaluate information and evidence and to make judgments
- develop skills and personal attributes that are needed for discipline-specific inquiry and that can be transferred to other areas in life
- build collaborative and cooperative working relationships
- use appropriate technology as a tool to help them gather and analyze information, solve problems, and communicate.

Disciplines are key in the aims and vision, although they serve a citizenship oriented agenda. The formulation is, however, somewhat equivocal in equating recognized academic disciplines (history, geography) with the non-disciplinary composite social studies. The goals of the three component disciplines of social studies are:

Goals of social studies	Developing a sense of who I am, and who we are	Where have I come from? What makes me belong? Where are we now? How can I contribute to society?
Goals of history	Developing a sense of time	Who are we? Who came before us? How have we changed?
Goals of geography	Developing a sense of place	What is where, why there, and why care?

The table differentiates history from geography by allocating "time" to the former and "space" to the latter. This is a difficult distinction, however, as "why there?" is a question that cannot be answered synchronically. Social studies is constructed as being about identity (although it does not explicitly say this) although the question "Where have I come from?" could also be interpreted as a place and time question and "where are we now" is also clearly a time question. The tacit assumption is that orientation in narratives linking past and future (i.e. historical consciousness) is separable from historical thinking, but this is arguable (Wilschut, 2010; Rüsen, 2005).

Scope

The roles of the disciplines within social studies are captured by the MOE (2013a) as follows:

Social Studies	**History**	**Geography**	**Politics**	**Economics**	**Law**
Significance	Historical significance	Spatial significance	Political significance	Economic significance	Legal significance
Cause and consequence	Cause and consequence		Objectives and results	Cause and effect	

Continuity and change	Continuity and change		Stability and change		Continuity and change
Patterns and trends		Patterns and trends		Stability and variability	
Interrelation-ships		Interrelation-ships			Interrelation-ships
Perspective	Historical perspective	Geographical perspective	Political perspective	Economic perspective	Legal perspective

Inquiry processes are treated in a generic manner at some length in the document. It is claimed, however, that:

> Each subject brings a particular way of thinking through content, and a different approach to the inquiry process. Skills and strategies for each stage of the social studies, historical, and geographic inquiry processes need to be taught explicitly. The type of questions asked, the information, evidence, and/or data gathered, and the analysis applied will vary by subject.

World Studies

The world studies curriculum at Grades 11-12 is older than the Grades 7-10 curricula and consists of courses in five subjects: economics, geography, history, law, and politics and is referred to as a 'discipline' whose main goals are to help students to:

- gain an understanding of the basic concepts of the subjects taught at this level, as a foundation for further studies in the discipline
- develop the knowledge and values they need to become responsible, active, and informed Canadian citizens in the twenty-first century
- develop practical skills (such as critical-thinking, research, and communication skills), some of which are particular to a given subject in Canadian and world studies and some of which are common to all the subjects in the discipline
- apply the knowledge and skills they acquire in Canadian and world studies courses to better understand their interactions with the natural environment; the political, economic, and cultural interactions among groups of people; the relationship between technology and society; and the factors contributing to society's continual evolution.

The curriculum is structured:

> Around a set of fundamental concepts: *systems and structures*; *interactions and interdependence*; *environment*; *change and continuity*; *culture*; and *power and governance*. Economics, geography, history, law and politics offer different perspectives on these concepts. In history, for example, *change and continuity* may be applicable to the relatively short period covered by the story of a country or a person. In geography,

on the other hand, this same concept may be applicable over much longer time periods covering the slow, almost imperceptible, changes in certain physical features.

Secondary: History

Orientation:
In history, students work towards:

- developing an understanding of past societies, developments, and events that enables them to interpret and analyze historical, as well as current, issues
- analyzing how people from diverse groups have interacted and how they have changed over time
- understanding the experiences of and empathizing with people in past societies
- developing historical literacy skills by analyzing and interpreting evidence from primary and secondary sources.

Three tools and strategies are identified as "necessary… to help students achieve the vision for learning" and these are:

- the citizenship education framework
- the concepts of disciplinary thinking
- the inquiry process.

The conceptualization of the discipline of history draws on the work of Peter Seixas in British Columbia.

> Competent historical thinkers understand both the vast differences that separate us from our ancestors and the ties that bind us to them; they can analyze historical artifacts and documents, which can give them some of the best understandings of times gone by; they can assess the validity and relevance of historical accounts, when they are used to support entry into a war, voting for a candidate, or any of the myriad decisions knowledgeable citizens in a democracy must make. All this requires "knowing the facts", but "knowing the facts" is not enough. Historical thinking does not replace historical knowledge: the two are related and interdependent (Seixas 2008).

History involves the study of diverse individuals, groups, and institutions as well as significant events, developments, and issues in the past. The Grade 7 and 8 history program provides students with an overview of Canadian history, from pivotal events in colonial North America during the early eighteenth century to issues facing a young nation on the eve of World War I. It conveys a sense of the dynamic nature of Canada and of its interconnections with other parts of the world. Students learn that Canada has many stories, and that each one is significant and requires thoughtful consideration. Students develop a way of thinking about history through the

application of the concepts of historic thinking. They will also learn how to apply the historical inquiry process, gathering, interpreting, and analyzing historical evidence and information from a variety of primary and secondary sources in order to investigate and make judgments about issues, developments, and events of historical importance.

The study of history enables students to appreciate Canadian heritage and identity, the diversity and complexity of Canadian society, and the challenges and responsibilities associated with Canada's position in the world. In doing so, it helps prepare students to fulfill their role as informed and responsible global citizens. The study of history in Grades 7 and 8 builds on the skills, attitudes, and knowledge developed in social studies in Grades 1 to 6 and supports the further study of Canadian history in Grade 10 (MOE 2013a).

History enables citizenship education, in this formulation, but is not equated with it (in the final paragraph history is described as enabling appreciation and preparation but not as identical with either).

Grades 10-12 World Studies (history component)
A purpose statement for history is provided as follows:

> History is the study of the collective human experience. Just as an understanding of individual experience helps people shape their life and work, so knowledge of collective human achievements and failures helps them interpret and shape subsequent events on the regional, national, and international stage.
>
> The study of history not only fulfils a fundamental human desire to understand the past but also appeals to our love of stories. Through the narrative of history, we learn about the people, events, emotions, struggles, and challenges that produced the present and that will shape the future. Such knowledge teaches us that our particular accomplishments and problems are not unique – an important lesson at a time when the forces of globalization are drawing people of different cultures closer together.
>
> The study of history develops intellectual qualities and skills required in both humanistic and scientific fields. Historical inquiry helps students develop the cognitive skills of integration and synthesis and promotes effective writing skills. Interpreting research evidence calls for sensitivity and judgment, a willingness to recognize and account for one's own cultural assumptions, and a capacity to empathize with people living in different times and circumstances. These are qualities that students of history share with writers, artists, scientists, and philosophers. They are also related to interpersonal skills that are highly valued in the workplace. Finally, an understanding of history not only contributes to the development of personal identity but is also an important part of the education of an informed and responsible citizen.

As in earlier grades, a citizenship rationale is to the foreground here. The first paragraph underplays the importance of change, historicity and context in human experience, as Rüsen

(2005) and others have argued. The final paragraph attests to a generic understanding of historical learning (integration, synthesis and so on).

Coherence and Clarity:
Grades 7-8
Extensive learning outcomes are provided for both Grades 7 and 8. Overall expectations and key big ideas are identified for each grade.

> The big ideas provide context for the overall expectations and the concepts of disciplinary thinking that are related to them. The big ideas reflect the enduring understandings that students retain from their learning, transfer to other subjects, and draw upon throughout their lives.

Overall expectations for both Grade 7 and Grade 8 center on application, inquiry and understanding historical context, with grade 7 concentrating on the 18th century and grade 8 on the 19th. It is apparent that there is clear evidence of increased demand in the goals set for each grade in one of the three areas identified in the expectations but possibly not in the other two:

- expectations in relation to application change over time – at Grade 7 A1 students are asked to make comparisons between past and present and at B1 between one period in the past and another period in the past.
- progression / increased demand is apparent between both Grade 7 expectations and Grade 8 A1 where students are asked to apply substantive concepts to differentiate between different factors of change. There is progression between Grade 7 and Grade 8 B1 in the sense that differentiation between the experiences of groups is expected at Grade 8 B1.
- the inquiry and context expectations, however, remain static within and across Grades 7 and 8.

How clear and differentiated are the 'big ideas' that students are to take away from the two grades? There are clear differences between the various 'big ideas' but:

- it is not at all obvious that the differences amount to an increase in demand / progression in thinking, for example a big idea for Grade 7 (historical perspective; historical significance) states that "different groups responded in different ways to the shift in power in Canada from France to Britain" and for Grade 8, "people in Canada had different reactions to the creation and expansion of the country"
- the differences are poorly related to the concepts that they are explicitly linked to. It is not obvious that the strand B 'historical perspective; historical significance' idea is in fact a perspective / significance idea (it is more straightforwardly understood as an idea related to change).

Teaching approaches and questions likely to help promote specific expectations are found throughout the curriculum document that are likely to promote nuanced historical thinking, for example, “what social attitudes permitted slavery to exist in colonial Canada?”

Grades 9-10 World Studies (History)
Extensive learning outcomes are provided for Grades 10, overall expectations and key “big ideas” are identified for each element of the grade. While clear expectations and specific goals are present, there is little expectation of progression or increase in demand within the grades in terms of historical inquiry and skill development – the stated expectations apply “throughout the course.”

There is little evidence of progression in conceptual demand between Grade 7-8 and Grade 10. This is apparent when the learning outcomes statements for Grade 10 are compared with those for Grade 8. It is apparent that more complex content is addressed but also that the conceptual understandings required appear identical or similar. The overall expectations for the higher grades do, however, include the development of transferable skills and the historical focus shifts to: social, economic and political context; communities, conflict and cooperation; identity, citizenship and heritage (Canada 1914-present).

There are clear differences between the various ‘big ideas’ but, as was the case in Grades 7-10, it is less obvious that the differences amount to an increase in demand / progression in thinking. For example, in “social, economic, and political context” the concepts at first appear to present greater complexity than at the beginning of the course (whereas at first all that is required is a perception that groups in Canada had been impacted by international developments, this concept is further developed and the factors leading to these events are also to be explored); however, the final section reverts to the level of complexity of the first.

How far do these ‘big ideas’ represent an increase in challenge from Grades 7-8? In some respects they do not – the big idea that “this was a time of major transformation in Canadian identity” is no more complex than the earlier big ideas were. However, on the whole it is apparent that greater content complexity and greater within idea relational complexity prevails in the Grade 10 big ideas.

As with the Grade 7-8 curriculum, teaching approaches are discussed explicitly in the specification and questions likely to help promote specific expectations are discussed throughout the document.

As was noted above, the Grade 9-10 history curriculum is structured around generic concepts as “systems and structures; interactions and interdependence; environment; change and continuity; culture; and power and governance.”

These are transformed into the following headings in the history curriculum and the headings are used to organize content across all the history courses:

- *communities:* the development and interactions of communities may be viewed from local, regional, national, and world perspectives. Over time, communities and their interactions have changed as a result of a complex web of factors, including changing technologies and changing patterns of human migration. Communities interact with one another through commerce, cultural exchanges, colonization, war, and international agreements. Such interactions are at the heart of today's globally connected world. It is through the study of various types of communities that students begin to understand their own time and place in a broader context
- *change and continuity*: the flow of history is characterized by the interplay of change and continuity. For example, people have always lived in communities, but the structures of communities have varied significantly over time. Change may be gradual, as in the case of industrialization or the rise and fall of empires, or it may be sudden, as in the case of war and its consequences. Chronology, the sequencing of past events in the order in which they occurred, enables us to investigate continuity and change as well as cause-and-effect relationships in the study of history
- *citizenship and heritage:* citizenship implies rights, privileges, and obligations – although each is defined differently from generation to generation, and from one society to another. With respect to pre-modern history, this strand treats related concepts, such as the nature of authority in various societies and the relationship of individuals and groups to authority. Heritage refers to what we receive from the past, including institutions, social traditions, political practices, values, religion, architecture, and art forms. An essential aspect of history is the appreciation of the legacy of the past, through which students come to understand their connection to their heritage and their role as citizens
- *social, economic, and political structures:* human beings throughout time have organized themselves into social groupings: families, clans, tribes, classes, castes, communities, and nations. The study of these social structures considers the relationships among ordinary people in society, gender roles, forms of work, leisure activities, and the interaction between majorities and minorities. The investigation of economic structures deals with the what, how, and why of human production, distribution, and consumption of goods and services. The study of political structures considers distribution of power, political participation, and changes in government and legal systems
- *methods of historical inquiry and communication*: students of history use a wide range of skills and information technologies. In conducting research, they must draw on and evaluate the relevance and validity of primary sources, such as artifacts and original documents, as well as secondary sources, such as textbooks, reference works, and various electronic information sources. Students must be given opportunities to develop critical and creative thinking skills. They should develop a clear focus for their investigations by formulating appropriate questions on historical topics and issues, and developing plans to guide research. Students must learn to consider chronology and cause-and-effect relationships in order to successfully organize, analyze, interpret, and apply their findings. It is also essential that they

develop an ability to communicate their findings in a variety of written, oral, and visual forms.

Grade 11 and 12 History
Two courses – World History Since 1900: Global and Regional Perspectives (Grade 11) and Canada: History, Identity and Culture (grade 12) were analyzed in order to explore coherence across grades and also scope for progression. The analysis revealed that, by and large, the Grade 12 course makes greater demands on students than the Grade 11 course. This is true or almost all the strands apart from the final enquiry strand where there is no evidence of increased demand in Grade 12.

Scope:
In Grades 7 and 8, the expectations for both history and geography in each grade are also divided into two strands. The strands for history, which are organized chronologically across the two grades, focus on the story of Canada from the early eighteenth century until 1914. Students learn how to apply concepts of historical thinking and develop their understanding of how we study the past. The topics, concepts, and methodologies covered in these strands prepare students for the compulsory history course in Grade 10, which focuses on Canada from 1914 to the present. The topics for Grades 7 and 8 are listed below.

- Grade 7: New France and British North America, 1713–1800; Canada, 1800–1850: conflict and challenges
- Grade 8: creating Canada, 1850–1890; Canada, 1890–1914: a changing society.

This content is explained at greater length as follows:

> In Grade 7 history, students will examine social, political, economic, and legal changes in Canada between 1713 and 1850. They will explore the experiences of and challenges facing different groups in Canada during this period, and will compare them to the experiences of present-day Canadians. In this grade, students will be introduced to the historical inquiry process and will apply it to investigate different perspectives on issues in eighteenth- and early-nineteenth-century Canada, including issues associated with the shift in power from France to Britain. Students will learn about various groups that existed in colonial Canada and how they were affected by the conflicts and changes that characterized this period. They will begin to apply the concepts of historical thinking to their study of Canadian history, leading to deeper and more meaningful explorations of life in colonial Canada. Students will also develop their ability to gather and critically analyze evidence from primary sources in order to form their own conclusions about historical issues and events.
>
> In Grade 8 history, students will build on their understanding of earlier Canadian history, examining how social, political, economic, and legal changes in Canada between 1850 and 1914 affected different groups in an increasingly diverse and regionally distinct nation. They will explore experiences of and challenges facing

> Canadians around the beginning of the twentieth century and will compare them to those of present-day Canadians. Students will examine the internal and external forces that led to Confederation and territorial expansion and of the impact of these developments on long-time Canadians, including First Nations, as well as new immigrants. Through an examination of inequalities in the new nation, students will learn that many of the rights and freedoms we have in Canada today are the result of actions taken by people in this era to change their lives. Students will develop their ability to apply the concepts of historical thinking as well as the historical inquiry process, using both primary and secondary sources to explore the perspectives of groups on issues of concern to Canadians from the mid-nineteenth century to the eve of World War I.

It is apparent that the Grade 7-8 curriculum is a narrow curriculum (focused on a two hundred year period in one country). This weakness in breadth is also, arguably, a strength in depth, as students will have opportunity to explore this narrow temporal and geographic content range in detail.

Grades 9-10 World Studies (History)
Two courses are available – academic and applied – the comments below focus on the academic course. Courses are available as full or half credit courses (two of the latter in a subject may be combined provided that the overall learning outcomes for subject are met). The history course appears only to be available in Grade 10.

The content of the Grade 10 history curriculum is as follows – each course has five strands. Strand A, historical inquiry and skill development, is followed by four content strands, which are divided chronologically. The five strands are as follows:

a) historical inquiry and skill development
b) Canada, 1914–1929
c) Canada, 1929–1945
d) Canada, 1945–1982
e) Canada, 1982 to the present.

Strand A follows the same model for concepts and inquiry skills central to Grades 7-8 and is integrated into each of the remaining four strands. The indicative content of strands B-E combined is outlined as follows:

> This course explores social, economic, and political developments and events and their impact on the lives of different groups in Canada since 1914. Students will examine the role of conflict and cooperation in Canadian society, Canada's evolving role within the global community, and the impact of various individuals, organizations, and events on Canadian identity, citizenship, and heritage. They will develop their ability to apply the concepts of historical thinking and the historical

inquiry process, including the interpretation and analysis of evidence, when investigating key issues and events in Canadian history since 1914.

Again, it is apparent that the Grade 10 curriculum is narrow (focused on one century in one country with reference to the rest of the world where its history impacts that one country). Again, this weakness in breadth is also, arguably, a strength in depth, as students will have opportunity to explore this narrow temporal and geographic content range in detail (a conclusion supported by the large number of specific expectations associated with the content).

Grades 10-12 World Studies (History)
Nine distinct history courses are available under the world studies program – five at Grade 11 and four at Grade 12 according to the student's post-secondary destination (one of the latter is intended for home learners and/or adults).

There is potential at Grades 11-12 to break out of the narrow geographical and temporal range that has characterized the previous grades. It is also apparent, however, that it is possible to continue to maintain a narrow focus. Again, however, depth is possible and for all courses a number of clear and detailed objectives are to be met.

Levels of Demand:
Grades 7-8 History
It is difficult to comment on level of demand without seeing the work that students produce. However, as has been students are expected to master history in levels of depth that seem both challenging and achievable by the age group. As has also been noted, however, the conceptual demands made by the syllabus are less coherent than they might be in a number of respects and static in the levels of demand set, on the other hand.
.
Attention is given throughout the syllabus to making the courses accessible. Well-being and students affective and other needs are foregrounded and a number of modes of learning are recommended (for example, field work) and detailed comment is present on making the curriculum accessible to learners with different backgrounds and needs.

Grades 10-12 World Studies (History)
The Grade 11 and 12 courses appear appropriate for the age groups and comparable (for example) to the demands made at AS and A2 in England. There is good evidence of increased demand at Grade 12 and scope for progression between grades. Like the Grades 7-10 curricula, the Grade 11-12 curricula contain statements on access and support for students with variable needs. In addition (and as at Grades 9-10) there is provision for half and full courses.

Assessment:
Grades 7-8 History
There is a clear focus on assessment for learning and on formative assessment. Assessment is against clear expectations for each grade and since it is teacher assessment, there is considerable scope for flexibility of approach.

Students are assessed in terms of their:

- knowledge and understanding
    - knowledge of content
    - understanding of content
- thinking
    - use of planning skills
    - use of processing skills
    - use of critical/creative thinking processes
- communication
    - expression and organization of ideas and information in oral, visual, and/or written forms
    - communication for different audiences and purposes in oral, visual, and/or written forms
    - use of conventions, vocabulary, and terminology of the discipline in oral, visual, and/or written forms
- application
    - application of knowledge and skills in familiar contexts
    - transfer of knowledge and skills to new contexts
    - making connections within and between various contexts.

Grades 10-12 World Studies (History)
As was the case with the earlier grades, assessment is teacher assessment by portfolio and assessment is substantially formative in intent. Clear statements are provided to allow portfolios of work to be graded in a criterion referenced manner, with 70% of assessment continuous over the course and 30% terminal.

Key competencies
Grades 7-8 History
There is extensive attention to key competencies in the syllabus in the sense that specific attention is paid to the development of literacy, financial and mathematical literacy, the development of inquiry skills, critical thinking and critical literacy and the development of IT skills in the curriculum document.

Problem solving and other thinking skills are clearly foregrounded in citizenship outcomes and in the assessment framework.

Grades 10-12 World Studies (History)

Again, as was the case at the earlier grades, the section of the syllabus devoted to program planning contains material showing how the program aims to cultivate key competencies and these are key to the overall rationale of the specification.

Social Studies: Geography Grades 7 to 12

Grades 7-8
In geography, captured by the well-known epithet 'what is where, why there and why care[7]? and defined by the statement "developing a sense of place", the goals are specified as follows, students will work towards:

- developing an understanding of the characteristics and spatial diversity of natural and human environments and communities, on a local to a global scale
- analyzing the connections within and between natural and human environments and communities
- developing spatial skills through the use of spatial technologies and the interpretation, analysis, and construction of various types of maps, globes, and graphs
- being responsible stewards of the Earth by developing an appreciation and respect for both natural and human environments and communities.

Coherence and Clarity:
The unresolved tension referred to above is perhaps illustrated by the tabulation of concepts of disciplinary thinking *across* subjects, which seems to imply that "continuity and change" is something that does not concern geographers. However, particularly in the specification for geography in Grade 7 and 8, the attempt to set out clear and specific goals is successful, providing an appropriately challenging range of topics (across both physical and human geography). These are described in terms of expectations, concepts and big ideas, and framing questions. Sample activities are also provided.

Scope:
The subject content at Grades 7 and 8 is well chosen, especially in relation to the more restricted geographical range of Grades 1-6:

Grade 7:
a) physical patterns in a changing world
b) natural resources around the world: use and sustainability

Grade 8:
a) global settlement: patterns and sustainability
b) global inequalities: economic development and quality of life.

[7] Charles Gritzner, "Defining Geography: What Is Where, Why There, and Why Care", accessed at http://apcentral.collegeboard.com/apc/members/courses/teachers_corner/155012.html.

The four concepts of geographic thinking – spatial significance, patterns and trends, interrelationships, and geographic perspective – underpin all thinking and learning in geography.
Level of demand:
The document describes a convincing level of demand in geography especially at grade levels 7 and 8. Thus, the specification is inviting an awareness of patterns and interrelationship on a world – and global scale. A matter of discussion may be on the balance between knowledge and understanding and the application/citizenship outcomes that are emphasized, thus, although, for example, physical processes are referred to in the program for Grade 7A above, it is not clear what level of demand is expected here.

Progression:
There is a strong sense of progression in the document, provided not least by the tabulation in appendix C on continuum of mapping and graphicacy skills. In addition there is a detailed glossary that should help teachers' planning for progression.

Assessment:
A clear section on assessment principles goes on to describe the provincial four-level reporting system. However, the descriptors are inevitably generic and make little demands – for example on specific expectations as the geographical knowledge and understanding.

Key competencies:
These are highly prominent throughout the document. Considerable space is devoted at various stages within the document to set out and reinforce key competencies as the overall goals, located in a discourse that includes health and well-being and "ability to learn."
This presumably is one reason why this document contains quite extensive pedagogic advice as well as setting out the curriculum requirements.

Grades 9-12
The structure of the social studies document, revised in 2013, follows the same structure as the Grades 1-8 document – and contains the same broad goals. However, the discipline of geography has all but disappeared. There appears to be only one reference to geography:

> Through their studies in social sciences and humanities courses, students are able to bring a broader perspective, integrate useful knowledge, and apply critical-thinking skills when studying other subjects such as history, geography, arts, and English.

Instead, students can take courses in social studies and the humanities: equity studies; family studies; general social studies; philosophy; and world religions.

Vocational education

Orientation:
TVET is taught to all students across Canada. The Learn Canada 2020 program has been established nationally, but each province has its own approach to TVET within that framework.

Both Ontario and Alberta recognize the vocational / apprenticeship route as a means of accessing higher education. Technological education is an important part of the curriculum from Grade 9. The preface to the curriculum handbook states:

> Technological innovation influences all areas of life, from the daily lives of individuals to the work of business and government, to interactions on a global scale. It helps meet basic human needs and provides tools for improving people's lives and exploring new frontiers. The policy outlined in this document is designed to ensure that technological education in Ontario enables students to meet the challenges and opportunities of the twenty-first century.

The goals of the technological education curriculum are stated as to enable students to:

- gain an understanding of the fundamental concepts underlying technological education
- achieve the level of technological competence they will need in order to succeed in their postsecondary education or training programs or in the workplace
- develop a creative and flexible approach to problem solving that will help them address challenges in various areas throughout their lives
- develop the skills, including critical thinking skills, and the knowledge of strategies required to do research, conduct inquiries, and communicate findings accurately, ethically, and effectively
- develop lifelong learning habits that will help them adapt to technological advances in the changing workplace and world
- make connections that will help them take advantage of potential postsecondary educational and work opportunities.

By Grade 10, some industry specific material is introduced. A Grade 10 student is likely to study a technology course for up to 330 hours of taught time. This time allows for practical work and teachers are advised that this should reflect current industry practices and standards.

The introduction to the options for Grades 11-12 emphasizes the practical nature of the technological curriculum, but this is not expressed as being "non academic":

> The philosophy that underlies broad-based technological education is that students learn best by doing. This curriculum therefore adopts an activity-based, project-driven approach that involves students in problem solving as they develop knowledge and skills and gain experience in the technological subject area of their choice.
>
> Rather than focusing on specific occupations, courses in this broad-based technology curriculum explore groups of related occupations and industry sectors within particular subject areas. So, for example, workplace preparation courses in construction technology enable students to acquire knowledge and skills related to carpentry, electrical/network cabling, heating and cooling, masonry, and plumbing.

Coherence and Clarity:
The educational content, learning aims and assessment criteria of the technological curriculum are set out very clearly in the Ontario Curriculum. In its presentation it is given parity with other curriculum areas:

> This course enables students to further explore and develop technological knowledge and skills introduced in the elementary science and technology program. Students will be given the opportunity to design and create products and / or provide services related to the various technological areas or industries, working with a variety of tools, equipment, and software commonly used in industry. Students will develop an awareness of environmental and societal issues, and will begin to explore secondary and postsecondary education and training pathways leading to careers in technology-related fields.

Schools are encouraged to develop broad-based courses built around the content and descriptors in the curriculum specifications. These might relate to technologies that have a local importance. There are a wide variety of options. To take just one example:

> Exploring communications technology: this exploratory course introduces students to concepts and skills in communications technology, which encompasses television / video and movie production, radio and audio production, print and graphic communications, photography, and interactive new media and animation. Students will develop an awareness of related environmental and societal issues, and will begin to explore secondary and postsecondary pathways leading to careers in the field.

Scope:
For Grades 9 and 10 the curriculum emphasizes the cognitive skills that underpin technology. They are reproduced in full here as an admirably elegant statement of the wider values of a practical curriculum.

- original and creative thinking resulting in the effective design of a product or service
- material: any substance or item used in the creation of a product or delivery of a service
- mechanism: a system of connected parts that allows a product to work or function
- power and energy: the resource that enables a mechanism to perform work
- safety: the care and consideration required to ensure that the product, process, or service will not cause harm
- structure: the essential physical or conceptual parts of a product, process, or service, including the way in which the parts are constructed or organized
- systems: the combinations of interrelated parts that make up a whole and that
- may be connected with other system
- aesthetics: the aspects of a product, process, or service that make it pleasing to the human senses

- control: the means by which a device or process is activated or regulated
- environmental sustainability: the creation of products or services and use of resources in a way that allows present needs to be met without compromising the ability of future generations to meet their needs. An important related concept is that of environmental stewardship – the acceptance of responsibility for the sustainable use and treatment of land and other natural resources
- ergonomics: the design of a product, process, or service in a way that takes the user's well-being with respect to its use or delivery into account – that is, in a way that minimizes discomfort, risk of injury, and expenditure of energy
- fabrication / building / creation: the act or process of assembling components and/or materials and resources to create a product or service
- function: the use for which a product, process, or service is developed.

In Grade 9 there is a single introductory technology course, exploring technologies. In Grade 10 the emphasis remains on generic skills, but these are developed within the context of one (of ten) vocational areas. Students may select these: the outcomes are said to be achievable by all students, and are designed to appeal to students' interests, "and to prepare them for active and rewarding participation in society." They are not regarded as training students for a specific job.

In Grades 11 and 12 technological education offers students optional, more specific courses that relate to their interests and career aspirations that will prepare them for further study or employment in a technological field of their choice. The Grade 11 and 12 curriculum also offers optional technological courses for university/college entrance, workplace preparation, and more generalized, less career specific courses. Courses in technological education are optional, but students can use them to meet a compulsory credit requirement for the Ontario Secondary School Diploma. The curriculum guide also recommends technological education courses for inclusion in programs that lead to a diploma with a Specialist High Skills Major designation. Suitable courses include:

- communications technology
- computer technology
- construction technology
- green industries
- hairstyling and aesthetics
- health care
- hospitality and tourism
- manufacturing technology
- technological design
- transportation technology.

Levels of Demand:
The generic skills against which students are assessed are grouped in to four areas: understanding, making, social awareness and career awareness. The core concepts remain

the same, but the complexity and sophistication increases. For example for Grade 9:

- understanding
    - demonstrate an understanding of the fundamental concepts and skills required in the planning and development of a product or service, including the use of a design process and/or other problem-solving processes and techniques
    - demonstrate the ability to use a variety of appropriate methods to communicate ideas and solutions
    - evaluate products or services in relation to specifications, user requirements, and operating conditions.
- making
    - problem-solving processes and project-management strategies in the planning and fabrication of a product or delivery of a service
    - fabricate products or deliver services, using a variety of resources
    - demonstrate an awareness of the effects of various technologies on the environment.
- Social awareness
    - demonstrate an awareness of how various technologies affect society, as well as how society influences technological developments
    - follow safe practices and procedures when using materials, tools, and equipment
- careers
    - identify careers in various technological fields, and describe the educational requirements for them.

By Grade 10, where individual career paths are first introduced, this becomes more workplace specific. For example in the Green Industry

- demonstrate an understanding of plant and/or animal biology and species classification as they relate to the green industries
- describe the factors affecting the growth and care of plants and / or animals
- demonstrate an understanding of design procedures and applications and production processes and systems as they relate to the green industries
- demonstrate competence in the use of mathematical, documentation, and communication skills as they apply to the green industries
- apply effective design and production practices as they relate to a variety of green industries
- demonstrate competence in applying introductory technical skills used in the green industries
- identify the impact of green industries on the environment and describe ways of minimizing harmful effects
- describe the societal implications of current practices and trends in the green industries

- describe the relationship of a variety of green industries to the local communities in which they operate.

By Grade 12 this increasing emphasis on workplace preparation has continued, representing a high level of understanding and performance, for example in Construction Engineering Technology:

- demonstrate an understanding of natural and manufactured materials, construction processes, and building components
- demonstrate an understanding of building codes, regulations, and standards that govern residential and light commercial construction project
- demonstrate an understanding of the systems in residential and light commercial buildings
- demonstrate an understanding of design considerations for residential and light commercial buildings
- use construction terminology correctly
- apply a design process, other problem-solving techniques, and related concepts and principles, as appropriate, to plan construction projects and develop solutions for construction problems and challenges
- create and interpret drawings of residential and light commercial construction projects
- determine, use and communicate accurate technical data for construction projects
- plan systems for residential and / or light commercial buildings
- apply the mathematical skills required in designing, laying out, and preparing estimates for residential and light commercial construction projects
- demonstrate appropriate technical skills, including the safe use of construction tools, equipment, and materials
- demonstrate safe and accurate building techniques
- apply various finishes to complete residential and light commercial construction projects
- identify careers in various technological fields, and describe the educational requirements for them.

Progression:
After upper secondary all Canadian students may opt for an apprenticeship route, or academic study towards university. Apprentices may study one to five years for a post secondary certificate or diploma. In Ontario, as in Alberta, the diploma may also lead to university also.

For Grades 11–12 the student choice of option determines which type of institution they will attend, college, workplace, or university as appropriate according to subject area. Technological education courses are available for inclusion in some programs leading to a Specialist High Skills Major (SHSM) or in programs designed to provide pathways to specific apprenticeship or workplace destinations. In some SHSM programs, technological education courses can be taken alongside other courses to provide the academic knowledge and skills important to particular industry sectors and required for success in the workplace and

postsecondary education, including apprenticeship. Technological education courses may also be combined with credits to provide the workplace experience required for some SHSM programs and for various program pathways to apprenticeship and workplace destinations. SHSM programs also include sector-specific learning opportunities offered by employers, skills-training centers, colleges, and community organizations.

Assessment:
The curriculum documentation is quite clear, that the primary purpose of assessment and evaluation is to improve student learning. The emphasis is on teacher assessment. "Information gathered through assessment helps teachers to determine students' strengths and weaknesses in their achievement of the curriculum expectations in each course. This information also serves to guide teachers in adapting curriculum and instructional approaches to students' needs and in assessing the overall effectiveness of programs and classroom practices."

Assessment is described as the process of gathering information from a variety of sources. These include assignments, observations, conversations, group work, demonstrations, projects, performances, and tests. Teachers are supported by clear definitions of the curriculum expectations in a course. As part of the assessment process teachers are required to provide students with descriptive feedback. Evaluation is described as "the process of judging the quality of student work on the basis of established criteria, and assigning a value to represent that quality."

Descriptors are detailed, and permit differentiation. For example,

- knowledge of content (e.g., facts, equipment, terminology, materials)
    - demonstrates limited knowledge of content
    - demonstrates some knowledge of content
    - demonstrates considerable knowledge of content
    - demonstrates thorough knowledge of content.

By Grade 12 the descriptors are appropriately sophisticated and stretching, if applied correctly. It is clear that there is some potential for grade inflation in the use of generalized, rather than specific, competencies.

Key competencies:
There is a strong emphasis throughout the technological curriculum on environmental responsibility. The *Shaping Our Schools, Shaping Our Future* publication (Government of Ontario 2007) states that environmental education is:

> the responsibility of the entire education community. It is a content area and can be taught. It is an approach to critical thinking, citizenship, and personal responsibility, and can be modeled. It is a context that can enrich and enliven education in all subject areas and offer students the opportunity to develop a deeper connection with

themselves, their role in society, and their interdependence on one another and the earth's natural systems.

The curriculum guidance also stresses that "literacy, mathematical literacy, and inquiry/research skills are critical to students' success in all subjects of the curriculum and in all areas of their lives."

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