British Columbia Ministry of Education

Curriculum Branch

Science Curriculum Review Report

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Table of Contents

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Introduction

Why is Science education important?

In today's world, a scientifically and technologically literate population is now more important than ever. As a global community, we are experiencing rapid and fundamental economic, environmental, social and cultural changes that affect our quality of life. "The emergence of a highly competitive and integrated international economy, rapid technological innovation, and a growing knowledge base will continue to have a profound impact on our lives." (Pan-Canadian p. 5). In recent years there has been an international movement towards educational reform, particularly in Science education, to meet the need for a sustainable environment, economy, and society. Science education will be a key element in developing scientific literacy among today's and tomorrow's youth. They will need to understand the key concepts and principles of Science and be able to use this knowledge and ways of thinking in everyday life (Kober, 1993). Science education will help enable tomorrow's population to have a better understanding of the world around them and to make sensible decisions.

"Science education must be the basis for informed participation in a technological society, a part of a continuing process of education, a preparation for the world of work, and a means for students' personal development." Science Council of Canada (1984)

What are some new directions for Science curriculum development?

In a rapidly changing society, the Science curriculum needs to be assessed and updated where necessary. The following trends in Science curriculum development have been identified at national and international levels.

- There is a trend to decrease the number of topics that are studied in Science and to take a more "depth" rather than "breadth" approach. Results of international studies show that the countries that score best in Science at the secondary level tend to cover fewer topics. (2061 today, 2000) In-depth understanding of Science concepts enables students to have a solid basis on which to build and acquire new knowledge and solve problems.

- Many jurisdictions are revising the curriculum to make Science personally relevant to the lives of students to instill lifelong learning. "Today, Science students often complain that the Science they learn in school plays no role in their lives, and they report little interest in continuing to learn Science (Linn & Hsi, 2000, p. 24)."

- For some time, there has been a trend to what is termed a constructive approach to creating Science curriculum. Constructivist curricula builds on major Science concepts by revisiting them with increasing sophistication at various levels. This may encourage a logical developmental sequence of important knowledge, skills and in-depth understanding that promotes Science learning in secondary Science courses.

Key components of a Science curriculum that develop scientific literacy

- address attitudes, skills, knowledge
- develop inquiry, problem-solving and decision-making abilities
- encourage creative, critical minds and strive for original thought
- enable students to sift through a wealth of information and ignore that which is unsound
- build on previous knowledge (constructivist approach)
- encourage a critical sense of wonder and curiosity to be life-long learners
- explore, analyse, evaluate, synthesize, appreciate
- emphasize relationships of Science, technology, society, and environment
- make real-world connections that focus on personal lives, community, careers, and the future to encourage responsible action

Current thinking on Content Standards in Science

Content standards outline what students should know and be able to do in Science. The summary of Science and content standards listed below have been collated from various American reports that represent current thinking in Science. (Kendall & Marzano, 2000). It is interesting to note that, in the previous edition of this book, there were 18 standards for Science. This supports the trend towards a "depth" rather than "breadth" Science curriculum.

<u>Summary of standards for Science</u>

Earth and Space Sciences

1. Understands atmospheric processes and the water cycle.
2. Understands Earth's composition and structure
3. Understands the composition and structure of the universe and the Earth's place in it

Life Sciences

4. Understands the principles of heredity and related concepts
5. Understands the structure and function of cells and organisms
6. Understands relationships among organisms and their physical environment
7. Understands biological evolution and the diversity of life

Physical Sciences

8. Understands the structure and properties of matter
9. Understands the sources and properties of energy
10. Understands forces and motion

Nature of Science

11. Understands the nature of scientific knowledge
12. Understands the nature of scientific inquiry
13. Understands the scientific enterprise

What is happening with the B.C. Science Curriculum?

The updating and conversion of the K- 12 Science curriculum to the Integrated Resource packages (IRP) format was completed in 1998.

General Science	Senior Specialist Science
Science K-7 - 1995	Applications of Physics 11 and 12 - 1998
Science 8 to 10 - 1996	Biology 11 and 12 - 1996
	Chemistry 11 and 12 - 1996
	Earth Science 11 and Geology 12 - 1996
	Physics 11 and 12 - 1996
	Resource Sciences 11 and 12: Forests - 1997
	Science and Technology 11 - 1995

The Ministry of Education K-12 Provincial Curriculum Cycle requires the regular review of provincial curriculum to ensure that it continues to be both current and relevant. The Science curriculum is currently in phases 1 and 2 of the Curriculum Cycle. The focus of these two phases is the review of the K-12 Science IRPs for the purpose of determining what action, if any, should be undertaken in terms of IRP revision. Phase 3 involves producing the revised curriculum leading to the last phase of implementing the revised IRP. The four phases are defined below.

Curriculum Cycle

Phase 1: Input, Research, Review, and Planning

- maintaining a database of comments, and input from several sources
- coordinating provincial assessment activities with the curriculum cycle for the subject area
- collecting assessment results where available

Phase 2: Workplan Development and Consultation

- use of standard questionnaire instrument to seek input on several aspects of the IRP and its implementation
- preparation of a report on the status of the IRP/curriculum including requests for decision where changes, development work, or revisions are proposed
- provision of collected input to Overview Team and other partners for responses and recommendations

Phase 3: Curriculum Development or Revisions

- workplan completion
- production phase completion (print and electronic versions)
- implementation plan development in conjunction with Field Services and other partners where appropriate

Phase 4: Implementation

- Curriculum has Minister's Order
- Implementation plan executed by School Districts in conjunction with Field Services and other partners where appropriate

How does B.C. compare to other jurisdictions in national/international studies?

The Third International Mathematics and Science Study (TIMSS) 1995 and 1999

This study was designed to investigate the Mathematics and Science literacy of students in Grade 4, Grade 8 and Senior Science and Hands-on Problem Solving abilities. This study was administered in 1995 and repeated in 1999 for Grade 8 students.

Canadian and B.C. Results in 1995

- Canada placed very high among the participating countries with only Korea, Japan and the US scoring significantly higher in the Grade 4 results and B.C. had results as good as Canada.
- Overall, Grade 8 students in Canada did not perform outstandingly well in Science but B.C. was close behind Alberta in top countries.
- Environmental issues and nature of Science is the area that Canadians did best in relative to other countries and chemistry was the weakest area as it is most often taught in Gr. 9/10.
- In the Senior Science study Canadian students did as well or better than students from 17 of the other 20 participating countries. Scores for B.C. were in the same category as Canada as were scores from Alberta and Ontario.
- Canadian students' performance on the physics test was as good or better than that of students from 9 of the 15 other participating countries and B.C. students performed significantly better than the Canadian average.
- For all of the tests there was little gender differences in achievement.
- Science Hands-on Problem Solving tests were conducted with Grade 4 and 8 students. It was a way of testing students' knowledge of scientific content and procedures, as well as their ability to use that knowledge in reasoning and problem-solving situation. Relative to the other countries, Canada did well. However, the fact that Canadian students scored below 50 percent on three of the five Science tasks indicates that there is room for improvement in Grade 4.
- Canadian students were strongest at using scientific procedures and scientific investigating. They were generally able to follow instructions to conduct routine experimental operations, use tools to gather data, and interpret their data.
- Three areas were identified as being in need of greater attention in Canadian Science classrooms. First, students must be involved in hands-on Science activities and experiments to give them opportunities to learn scientific concepts and experience making inferences in Science-based situations. Second, students must be given opportunities to design and conduct hands-on experiments to develop the abilities to plan, conduct, and evaluate scientific investigations. Third, students must be given opportunities to communicate about Science through activities that allow them to present, explain, and apply concept knowledge using a variety of media and methods.

Canadian and B.C. Results in 1999

The 1999 TIMSS study involved Grade 8s from 38 countries. In B.C. approximately 1000 students from 42 schools took part in the assessment.

- The average performance of B.C. students (score of 54) in Science was significantly higher than the international averages and not significantly different than the Canadian averages (score of 53).
- Alberta was the only province with Science scores that were significantly higher than B.C.
- TIMSS results for B.C. students in Science were not statistically different from 1995 to 1999. In general, the TIMSS-99 results are comparable to the results of other Science assessments in which B.C. has participated.
- No gender differences in Grade 8 students' achievement in Science were found in B.C. in either the 1995 or the 1999 studies. This is consistent with findings in other assessments. In addition to the 1999 and 1995 TIMSS assessments, males and females have performed about the same in the numeracy components of recent provincial Foundation Skills Assessments, the 1999 national Science assessment, and the 1997 national Mathematics assessment.
- B.C. students generally held positive attitudes towards Science.

School Achievement Indicators Program (SAIP)

This study is a national Science assessment that was conducted by the Council of Ministers of Education, Canada in 1996 and 1999. The performance of thirteen- and sixteen-year-olds from across the country was assessed using a written test and a practical task component. Results are reported according to five levels of achievement, level 1 being the basic level and level 5 the most complex. Approximately 1750 B.C. students participated in the 1999 study. Results show that:

- Canadian performance at higher levels in Science knowledge and skills improved significantly between 1996 and 1999.
- In 1999, for both age groups, no significant difference in achievement between males and females was observed for the written assessment and slightly more 13 year-old females performed at higher levels in the practical task assessment.
- In both age groups, B.C.'s students performed as well as or better than Canadian students as a whole. The performance of 13 year-old British Columbia students showed significant improvement between 1996 and 1999 at levels 3 and 4 while performance of B.C. 16 year-old students was significantly better in 1999 at level 3.
- Slightly more 13 year olds reached levels 1 and 3 than the Canadian average.
- Ninety-one percent of 13 and 16 year olds in B.C. felt that Science is an important school subject and 85% felt that many good jobs require the study of Science.
- B.C. schools reported the highest number of working and up-to-date computers in Canada. Despite the prevalence of computers in the schools, they are not commonly used as an instructional tool in Science (8% of 13 year olds and 12% of 16 year olds in B.C. reported using computers in Science classes a few times a week or more).

1995 British Columbia Assessment of Mathematics and Science

This assessment evaluated how well students in grades 4,7, and 10 understand various principles of Mathematics and Science, solve problems and apply higher-level thinking skills. It also measured students' attitudes about Mathematics and Science and gathered information on teaching practices in the classroom. It should be noted that this assessment was based upon the pre-IRP curricula.

- Although some of the 1995 Grade 4 ratings were satisfactory or above, Grade 4 students who participated in the 1991 assessment outperformed the 1995 students in all categories.
- The Grade 7 students' performance had slightly declined since 1991 but most students demonstrated a sound understanding of safety, the applications, limits and nature of Science and scientific vocabulary and physical Sciences. Their knowledge of life Sciences was rated as marginal, as was their achievement on Science skills and processes.
- In general, Grade 10 students demonstrated competence in Science. All areas of the assessment were satisfactory except they demonstrated only marginal knowledge of earth Science and understanding safety.

Taking into consideration all of the study results, students' achievement significantly improved - by more than six percent - on questions designed to test their knowledge of Science processes, but overall performance declined by nearly one percent since the 1991 assessment. The Ministry of Education developed the new Science IRPs using the recommendations contained in this assessment report.

The Second International Assessment of Educational Progress

In 1990-91, about 175,000 students from 20 countries, including more than 6,000 students from B.C. participated in this study that assessed the performance level of 9 and 13 year olds in Science and Mathematics and 13 year olds understanding of geography. British Columbia students performed very well particularly in the following areas:

- B.C. 13 year-old students excelled in the content area of Nature of Science, and in the cognitive process area of integrating knowledge
- B.C. Nine-year olds ranked first in Earth and Space Sciences
- There were no significant differences between gender scores
- B.C. students performed better on the Science components of the assessment than they did on the Mathematics component, when compared to other jurisdictions
- B.C. students ranked first in Mathematics and second to Alberta in Science , among the English-speaking 13 year olds.

Summary Report from Science in B.C. Discussion Day - October 20, 2000

This report was submitted by Lionel Sandner, University of Victoria and is not a Ministry of Education report. The full report summarizing the Science in B.C. Discussion Day can be read at http://web.uvic.ca/~lsandner/Final%20Report.htm.

The comments in this report are the voices of 162 Science teachers and stakeholders. The views are a reflection of professionals working hard to deliver the best possible Science program to B.C. students.

The purpose of the one day Science in B.C. conference was to begin the conversation on the status of Science education in British Columbia. It was **not** to develop recommendations on future directions of B.C. Science curriculum development. As a result, the comments reflect the views of many rather than a voice of the majority.

This is not to say there are no common themes emerging in Science education in B.C.. Rather, it's clear B.C. Science education and its curriculum is in a precarious position. While there are many examples of successes in the classroom, there are many concerns.

- Clearly the number one concern on Science teachers minds is the existing B.C. curriculum. Addressing the development of Science - Technology - Society and the Environment (STSE), knowledge, skills and attitudes has been identified as a challenge for teachers.
- Transition of students between grades, the students' understanding of Science concepts, and the placement of topics within grades are concerns.
- In the area of coordination and leadership, the lack of leadership is hampering the teaching of Science in classrooms across the province. In districts where this is not an issue, inevitably there are leaders who are working on mentoring and bringing teachers together. While not explicitly stated, this is probably done voluntarily.
- A complete lack of IRP specific resources and targeted funding for Science specific materials is creating increased workloads for teachers as they attempt to create their units.
- Teachers are in need of more inservice on the teaching of Science and how to create Science units that address the philosophy of the existing and any new Science curricula.

This is a problematic situation. It will require a focused effort by all those involved in Science education to address these concerns. While it may be easy to point to our successes and forget the concerns, we must remain diligent and address the concerns as they relate to curriculum, resources, professional development and assessment.

These themes, and their accompanying issues , are presented as the basis to begin a conversation of "what matters in Science education in British Columbia".

Summary of Science Overview Team Meeting February 10/11, 2000

This represents the compilation of the discussion at the Science Overview Team. This does not necessarily represent the views and opinions of the Ministry of Education.

Discussion of Science - Current State

The Science Curriculum up to Grade 10 does not filter out students as the Mathematics courses typically do. With this in mind, does the Science taught provide value to all students? What about the 75% of students who do not go on to University. There should be opportunities in place to validate those students that don't have university in mind. At the Grade 11/12 level the courses are driven by the Provincial Exams in terms of the content and depth of presentation. This leads to a de-emphasis of hands-on activities and learning with more pen and paper work. The loss of hands-on and the pressure of content has filtered down to lower and lower grades. The pressure of Post-Secondary requirements have further limited choices of academic students.

Most of the discussion centered around the provision of resources for Science programs. Comments made by members of the Overview Team suggested that the removal of many materials used for 'fun' activities and the concern over possible safety and liability has 'chilled' the Science programs. There is a need to provide clear guidelines on what is possible through the safety manual or similar sources. It was expressed several times that educators need resources of safe and fun activities. This would have the value of reinforcing the safety while promoting hands-on activities. The additional value would be to new and/or non-specialist teachers having to teach Science. This is common in elementary schools but is also an issue in junior Science. The move to middle school has lead to a hybrid (secondary/elementary) model that makes it less likely that Science specialists will be teaching Science classes.

The learning resource situation has provided another area of concern. Current learning resources have poor curriculum fit and in some cases recommended resources are unavailable. This is most noticeable in the elementary and Francophone programs. Any changes in the curriculum will only be successful if they are supported by resources that facilitate implementation.

There is a lack of funding provided for the purchase of consumables and science equipment. The cost of consumables outstrips the small discretionary budgets of many schools and districts. It is not uncommon for elementary schools to have no budget for Science supplies. The physical plant (facilities) that is available for Science instruction is also a resource issue. As schools have grown, the addition of classrooms has not generally included specialist spaces such as Science labs.

The emphasis on resources and support for non-specialist Teachers are issues that may help to address the inconsistent presentation of Science across the grades. The inconsistencies do not make the inclusion of Science, Science labs, and the Applications of Science strand obvious as part of students programs.

A communication plan consisting of development and implementation processes for the revised Science curriculum will need to be part of the review cycle. The use of PSA's communication sources, email, and web sites will improve communication but there is still the need for paper to reach the teacher's desk.

Specific directions from the discussion

- Science is a core area of study that is valuable to all students regardless of their future intentions
- Science is fun. The loss of the 'hands-on' activities and compelling demonstrations reduce the appeal of the course to all students.
- The Science curriculum is to be based on 'doable' activities and the availability of appropriate resources.
- The Science Safety manual is in need of critical updating to reflect current practice and to clarify requirements.

Summary of Science Overview Team Meeting February 9, 2001

This represents the compilation of the discussion at the Science Overview Team. This does not necessarily represent the views and opinions of the Ministry of Education.

Attendees
Darlene Monkman - Science Curriculum Coordinator; Wael Afifi - French Initiatives Coordinator; Marj Adams - B.C.ALMER; Karim Bandali - Student Voice; Don Ennis - B.C. School Trustees Association; Peter Freeman - B.C.TF; Linda George - Business Council of B.C.; Paul Harrison - Universities; George Hui - B.C. Confederation of Parent Advisory Councils'; Kathy Knight - Informal Science Education Institutions; Peter MacMillan - Universities; David Miller - B.C. School Superintendents' Association; Kitty Morgan - B.C.TF; Joe Rhodes - B.C. Principals' & Vice-Principals' Association.

Key points of Discussion
- Draft Science Curriculum Review Report
- Recommendations coming out of the Review Report
- Recommended direction that the Ministry of Education should take in Science Curriculum Revision

Elementary Science Education
- concern that there is a lack of equipment and the budget to make purchases
- need for teacher friendly equipment and Science kits to encourage curiousity
- teachers need to receive more in-service to learn more about teaching Science so that they feel comfortable
- suggested in-service models - mentoring, workshops, school-based and district-based Science resource teachers
- need for Provincial Science Curriculum Coordinator to be traveling around the province
- secondary school teachers do not feel that elementary teachers are teaching the basics
- many elementary teachers do not realize that the "Applications of Science" are PLOs and not an introduction to the IRP
- educators are working without learning resources and need guidance
- need to make Science cheaper "to do"

Grade 8-10 Science
- needs to be intensified as it has been watered down

Senior Science Courses

- driven by the provincial exams which degrades the quality of Science
- need for more cooperation between curriculum and exams branch to ensure tight link
- curriculum is designed for the 25% who continue immediately to post-secondary
- many teachers do not want the pressure of exams because the content is too heavy
- suggested that we have different streams of senior courses with and without provincial finals
- exams force accountability
- teachers have to also teach "how to write an exam"
- students are missing the basics when entering university

Science and Technology 11

- considered to be the "dummy" Science
- difficult to find resources
- it is often replaced by a locally developed course
- there is a need to change the image of the course and replace it with a more practical hands-on Science 11 course that is engaging and meaningful
- suggested that a course be created with options to give it a local flavour
- survey province to find out what is needed/missing

Technology in Science

- teachers are becoming more comfortable with computers and have adapted to using word processing but more could be done in regards to spreadsheets, graphing, software, etc.
- computers are not being used to their full potential in the Science classroom due to lack of teaching experience with technology and the lack of funds and time
- computers must be used as a tool in Science labs
- there is money to buy software but that does not give real Science experiences
- more integration of technology is needed, especially at the Senior level

Pan-Canadian Framework

- there was support, as in past Overview Meetings, to align to the framework
- the four foundations are good but it must be decided at which grade level the emphasis should be placed on the different foundations (for example, skills/attitudes is more important than content knowledge at K-7)

Curriculum Cycle

- recommended that revisions occur in the following order: - K-7, 8-10, Science and Technology 11, Science Safety Manual, Biology 11/12, Physics 11/12, Chemistry 11/12 and other Senior Science courses, as recommended after further evaluation.
- K-7 should be the first to be revised as there will be continuity; teachers at elementary may be less resistant to change; there is a need for aligned resources; students will be prepared for revised 8-10 curriculum
- need to address the problem areas that are in the current B.C. curriculum
- need to have a K-12 Science curriculum plan prior to revising K-7 IRP

Science Safety Manual

- safety manual could be divided and outlined to help the various grades
- make reference to the Safety manual in the IRPs so that teachers will know that it exists
- make it available online and in CD format

Recommendations

- start revisions with the K-7 IRP
- build the curriculum around the 4 foundations of the Pan-Canadian framework
- revise the Science Safety Manual within next two years
- have an implementation strategy prior to revising the IRPs as the revised curriculum must be supported in the field with strategies and resources
- Science and Technology 11 should be renewed/renamed with options for regional diversity
- need for better articulation between secondary and post secondary schools
- need Aboriginal representation on the writing team

What is happening on the international arena?

In the United States the efforts to improve Science literacy in schools have led to the adoption of Science standards or curriculum frameworks in 46 states. These standards present criteria for Science education that guide the phases of development of scientifically literate citizens. By outlining what students should know, understand, and be able to do in Science, these standards can serve as an important tool for judging the quality of students' learning.

One of the leading Science education initiatives is Project 2061 of the American Association for the Advancement of Science. A recent study by the Organization of Economic Cooperation and Development (OECD) described this project as the 'single most visible attempt at Science education reform in American history'.

The Project 2061 comprehensive package 'Benchmarks for Science Literacy', created the first set of specific recommendations for what students in grades 2,5, 8, and 12 should know and be able to do. In the process, the document shaped curriculum standards and frameworks across the US. The key for the benchmarks' success was the extensive research done to ensure that they were developmentally appropriate for the children, thus allowing students at different stages to build and elaborate on their previous knowledge.

Critics charge that the breadth of the curriculum in most states results in it not having any depth. William Schmidt, research coordinator at the U.S. TIMSS National Research Center compared curriculum guides and textbooks from several countries. He concluded that countries with more focused curriculum have constantly outperformed the U.S. with its 'mile-wide, inch-deep' approach. Schmidt gave the example of a widely popular 8th grade Science textbook that has 65 topics then pointed out that similar German and Japanese textbooks cover five topics only. It is felt that a smaller number of topics allows in depth coverage which in turn enhances students' learning and enables them to excel in international competitions.

Apart from the actual number of topics covered, the concept of benchmarks is gaining greater worldwide acceptance. In the United Kingdom, attainment targets set out the knowledge, skills, and understanding that students are expected to have by the end of each of three key stages at age 7, 11, and 14.

Revised Science programs also emphasize the development of a wider range of enquiry skills, contemporary Science and the applications of Science. In Australia, the 1999 Adelaide Declaration on National goals for Schooling in the 21st century recommended the development of key performance measures in Science.

A follow-up activity to the World Education Forum (26-28 April 2000, Dakar) focused on an initiative under the leadership of the UNESCO's Section for Science and Technology Education (STE). The major objective for STE was mobilizing children across the world on a number of themes related to Science and technology including the ideal Science education. Children's responses from around the world indicated that Science education programs are successful only when they motivate students or relate to their topics of interest.

This conclusion led the UNESCO's STE to stress the necessity of constantly reviewing Science curriculums. Such revisions and any adjustments that follow should take place under an important guiding principle illustrated in this child's vision of the ideal Science program: '*when I understand how to use it and why I should study it, I get very interested in Science.*'

What is happening with Science across Canada?

Pan-Canadian Protocol for Collaboration on School Curriculum - Common Framework of Science Learning Outcomes

British Columbia played a leading role in the development of the Pan-Canadian Science Framework. What follows is a description of the framework extracted directly from the document. It can be viewed online at http://cmec.ca/Science/framework/

> In February 1995, the Council of Ministers of Education, Canada adopted the Pan-Canadian Protocol for Collaboration on School Curriculum. The protocol acknowledges that education is a provincial and territorial responsibility, while recognizing that interjurisdictional co-operation can contribute to improving the quality of education in the country. In keeping with the protocol, participating jurisdictions believe that sharing human and financial resources can increase the quality and efficiency of the curriculum development processes in Canada. The Common framework of Science learning outcomes K to 12 (hereinafter called the framework) is the first joint development project initiated under the protocol. The framework sets out a vision and foundation statements for scientific literacy in Canada, outlines general and specific learning outcomes, and provides illustrative examples for some of these outcomes. The framework provides common ground for the development of curriculum within each participating jurisdiction, and may result in more consistency in the learning outcomes for Science across jurisdictions. Other potential benefits include a greater harmonization of Science curriculum for increased student mobility, the development of quality pan-Canadian learning resources, and collaboration in professional development activities by teachers of Science. Each jurisdiction will determine when and how the framework is to be used. All work on this project was done simultaneously in French and English. (p. 2-3)
>
> In light of the vision for scientific literacy and the need to develop scientific literacy in Canada, four foundation statements were established for this framework. Curriculum developers should note that these foundation statements delineate the four critical aspects of students' scientific literacy. They reflect the wholeness and interconnectedness of learning and should be considered as interrelated and mutually supportive. The learning outcomes in this framework are stated in relation to these foundation statements.

Foundation 1:

Science, technology, society, and the environment (STSE) -

Students will develop an understanding of the nature of Science and technology, of the relationships between Science and technology, and of the social and environmental contexts of Science and technology.

Foundation 2:

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.

Foundation 3:

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 4:

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. (p. 4)

Provincial/Territorial Science Curriculum Update

The following information has been collected from Provincial/Territorial Science Curriculum Coordinators and Ministry of Education's websites.

Atlantic Canada

The four Atlantic provinces, Prince Edward Island, Newfoundland, Nova Scotia and New Brunswick, have founded the Atlantic Curriculum Education Foundation (APEF) group. The APEF is a body that helps to coordinate the development of common curricula in Language Arts, Math, Science and Social Studies for use in the Atlantic Provinces. All Science curricula developed under this agreement are guided by the Science framework described in the *Foundation for Atlantic Canada Science Curriculum* and the Pan-Canadian *Common Framework of Science Learning Outcomes K-12* (Council of Ministers of Education, Canada, 1997). To date, new curriculum guides for grades 7 - 10, senior high physics and senior high chemistry have been completed. They are in the final stages of fine-tuning and completing the K-6 Science curriculum guides and senior high biology.

Quebec

The Science curriculum in Quebec is currently under reform as a result of the educational policy statement, Quebec Schools on Course (1997). The current programs for the preschool, elementary and secondary levels are gradually being replaced. The revised primary program will be available in August 2001. The secondary program is currently being revised using, in small part, the Pan-Canadian Framework as a reference tool. The reforms are expected to be completed by 2005-06.

Ontario

Ontario has recently revised the Science curriculum as follows: 1998 Grades 1-8 Science and Technology; 1999 Grades 9 and 10 Science and 2000 Grades 11 and 12. These courses are aligned with the Pan-Canadian framework. Also, they have produced a new Grade 12 Earth and Space Science course as well as multi-disciplinary Science courses for Grades 11 and 12. The writers of the Grades 11 and 12 courses incorporated, where possible, the outcomes of the Pan-Canadian framework into the courses.

Manitoba

Manitoba recently revised its Science program. As of December 2000, the Science curricula are Pan-Canadian aligned from K-9, and implemented in the system. Manitoba has stated that they intend to continue with the Pan-Canadian alignment at the Grade 10-12 levels, including a new strand in Integrated Science at the Grade 11/12 levels. They have designed the Science curriculum in accordance with the vision for scientific literacy articulated in the *Common Framework of Science Learning Outcomes K-12* (Council of Ministers of Education, Canada, 1997). Manitoba Science curricula are built upon the following five foundations for scientific literacy that represent the paradigm shift in Science education also evident across North America and Western Europe.

A. Nature of Science and Technology
B. Science, Technology, Society and Environment (STSE)
C. Scientific and Technological Skills and Attitudes
D. Essential Science Knowledge
E. Unifying Concepts

Saskatchewan

A revised Science curriculum was implemented in Saskatchewan in the early 1990s with some additions and upgrades since then but basically it is the same. Although Saskatchewan played a full role in developing the Pan-Canadian Common Framework they have yet to begin the process of aligning the Science curriculum to the framework. This will take place as soon as possible with priority being given to Grade 10 Science, Grade 11/12 Earth Science and Elementary Science. Revision of the curriculum will depend on the availability of learning resources.

Alberta

Alberta has adopted the emphases and the skill organizers of the Pan-Canadian Common Framework across the secondary program. There is a fairly good match to the Pan-Canadian but not necessarily exactly the same topic in exactly the same grade. (See following table). The elementary program has a weaker connection to the Pan-Canadian Framework but they intend to align more closely on the upcoming revisions, primarily because of resources. Provincial implementation of Grade 7 and 8 Science begins in 2002. Grade nine will be implemented in 2003 and each higher grade will be implemented on an annual basis from that point. Implementation is expected to be completed by 2007. The elementary curriculum will be reviewed in 2003 or 2004 with a new curriculum in place by 2008-2009. The single major project at this time is to place all of their curriculum materials on a searchable database.

Northwest Territories

The Northwest Territories is currently rewriting all K-12 Science curricula over the next 4 years. The work-plan is November 2000-June 2001 Grade 7-9, 2001-2003 - Grade 10-12 and 2003-2004 Kindergarten to Grade 6. The K-10 curriculum will parallel the Pan-Canadian Framework quite closely as with the 11-12 Biology and Chemistry. Physics 11/12 will be the same as Alberta Learning as they use their diploma exams. At senior secondary there is a revision of some of the other Science programming. The NWT will be using a three pathway approach for grades 10, 11, and 12 Science.

Pathway One: Science 10 (general / academic Science), Bio 11-12 Chem 11-12, Physics 11-12

Pathway Two: Occupational Certification, Trades and Apprenticeship (OCTA Science10-11-12). This pathway will prepare students for Occupational Certification, Trades and Apprenticeship prerequisite skills in Science and is based on national entry level standards. The draft consultation frame work is scheduled for completion by June 01.

Pathway Three: Experiential Science (ES) 10-11-12 is designed for academic and nonacademic students, where students do hands on Science and the theory is brought in as required. Students participate in research type projects throughout the year. The Science is taught in context where student data is based on recognized protocols enabling the data to be used by other researchers.

All pathways will have some connection to the Pan-Canadian Framework. The OCTA and ES will have the skills, attitudes and Science, Technology, Society and Environment (STSE) incorporated to a higher degree than the knowledge component since the outcomes of these courses may not have equivalents in the PCSF.

Yukon

The Yukon Education system follows the British Columbia Ministry of Education for Grade 7 to 12 Science and their students are eligible to write the B.C. governmental exams. They are currently revising the K-6 Science program but it will not be specifically aligned to the Pan-Canadian Framework.

Nunavut

Nunavut is moving forward with curriculum revision. In elementary Science they are creating a thematic based curriculum that incorporates traditional Inuit knowledge while aligning to the Pan-Canadian Framework. There will be an 80 to 85% alignment to the Pan-Canadian at the Junior High and High School level as well as an experiential stream relating to water and terrestrial ecosystems with the integration of traditional Inuit knowledge. The Nunavut education system has close ties with the Alberta system.

B.C. Science Revision and the Pan-Canadian Framework (PCSF)

The Pan Canadian Science Framework (PCSF) document represents a monumental step along the path to the goal of generating excellence, consistency, or commonality in Canadian K-12 Science education. However, it should be noted that the PCSF has some serious deficiencies. The PCSF has significant problems with sheer volume, repetitive and redundant detail, document structure, language use, curriculum design, and Science. The PCSF does not clearly identify and develop the major themes of Science although most of them may be found among the learning outcomes.

Specific Concerns Include:

- Number of Outcomes - The PCSF document has 1246 outcomes and 81 general learning outcomes for K-10. The sheer number suggests that there is a potential problem for curriculum developers, students, teachers and resource developers alike.
- Repetitive and Redundant Detail - A considerable portion of the volume of the PCSF document comprises duplicate or near duplicate outcomes that occur at several grade levels and several times within the same grade level. Many of the outcomes are statements of Science related activities instead of descriptions of what a student is expected to know or be able to do at each grade.
- Document Structure - There does not seem to be a unifying curriculum design that supports the use of such a large number of organizers in the PCSF document. There is a need for an ordered sequence to make the expectations easier to understand.
- Language - There are numerous instances of grammatical problems.
- Curriculum Design and Content - Many of the outcomes are not completely Science related.
- Science - Within the outcomes of the PCSF there appear to be some content gaps, weaknesses, repeated topics and incorrect Science.

Recommendation

It is recommended the B.C. seek to incorporate the vision statement as well as the four Foundation statements of the PCSF within its next revisions of the K-12 Science curriculum but develop a more cohesive framework of K-12 standards, benchmarks, and learning outcomes based on the generally accepted major themes of Science.

Table comparing three provincial Science curriculum topics to Pan-Canadian Framework topics

British Columbia	Pan-Canadian Framework	Ontario	Alberta
Kindergarten			
Plant and animal characteristics	Exploring the world with our senses		Community and environmental awareness
Properties of objects			
Force and motion			
Earth's surface			
Grade 1			
Plant and animal life cycles	Needs and characteristics of living things	Characteristics and needs of living things	Needs of animals and plants
Properties of matter	Properties of objects and materials	Characteristics and objects and properties of materials	Senses
Changes	Materials and our senses	Energy in our lives	Creating colour
Weather and seasons	Daily and seasonal changes	Daily and seasonal cycles	Seasonal changes
		Everyday structures	Building things
Grade 2			
Animals in the environment	Animal growth and changes	Growth and changes in animals	Small crawling and flying animals
Properties of matter	Liquids and solids	Properties of liquids and solids	Exploring liquids
Sound	Relative position and motion	Energy from wind and moving water	Buoyancy and boats
Earth's composition	Air and water in the environment	Air and water in the environment	Hot and cold temperatures
Body systems: hearing, speech		Movement	Magnetism
Grade 3			
Plants in the environment	Plant growth and changes	Growth and changes in plants	Animal life cycles
Magnetism	Invisible forces	Magnetic and charged materials	Testing materials and designs
Energy in our lives	Materials and structures	Forces and movement	Hearing and sound
Sky above us	Exploring soils	Soils in the environment	Rocks and minerals
		Stability	Building with a variety of materials

British Columbia	Pan-Canadian Framework	Ontario	Alberta
Grade 4			
Adaptations of organisms	Habitats and communities	Habitats and communities	Plant growth and changes
Body systems: digestive, skeletal, muscular	Sound	Light and sound energy	Light and shadows
Simple machines	Light	Pulleys and gears	Wheels and levers
Electricity	Rocks, minerals and erosion	Rocks, minerals and erosion	Waste in our world
Water		Materials that transmit, reflect, or absorb light or sound	Building devices and vehicles that move
Grade 5			
Body systems: respiratory, circulatory, sensory	Meeting basic needs and maintaining a healthy body	Human organ systems	Electricity and magnetism
Materials in our world	Properties and changes in materials	Properties of and changes in matter	Classroom chemistry
Light and colour	Forces and simple machines	Forces acting on structures and mechanisms	Mechanisms using electricity
Atmosphere and weather	Weather	Weather	Weather watch
B.C.'s living resources		Conservation of energy	Wetland ecosystems
Natural resources			
Grade 6			
Classification of organisms	Diversity of life	Diversity of living things	Trees and forests
Microscopic world			Evidence and investigation
Chemical and physical changes	Electricity	Electricity	
Forces			Air and aerodynamics
Space exploration	Space	Space	Sky Science
Solar system	Flight	Motion	Flight
Grade 7			
Ecology	Interactions within ecosystems	Interactions within ecosystems	Interactions and ecosystems
Environmental chemistry	Mixtures and solutions	Pure substances and mixtures	Plants for food and fibre
Energy sources and options	Heat	Heat	Heat and temperature
Earth's crust	Earth's crust	The earth's crust	Planet earth
Astronomy		Structural strength and stability	Structures and forces
Body systems: reproduction, growth and change			

British Columbia	Pan-Canadian Framework	Ontario	Alberta
Grade 8			
Diversity	Water systems	Water systems	Fresh and saltwater systems
Social issues: resources, pollution	Optics	Optics	Light and optical systems
Global ecosystems	Cells and systems	Cells, tissues, organs and systems	Cells and systems
Matter, properties, and the periodic table	Fluids	Fluids	Mix and flow of matter
Energy		Mechanical efficiency	Mechanical systems
Geological processes			
Grade 9			
Body systems	Reproduction	Reproduction	Biological Diversity
Factors affecting body systems			Environmental chemistry
Elements, compounds and reactions	Atoms, elements, reactions	Atoms and elements	Matter and chemical change
Force and energy	Electricity	The characteristics of electricity	Electrical principles and technologies
The solar system and the universe	Space exploration	The study of the universe	Space exploration
Grade 10			
Cells	Ecosystems	The sustainability of ecosystems	Flow of matter in living systems
Genetics			
Chemicals and reactions	Chemical reactions	Chemical processes	Energy and matter in chemical change
Electricity and magnetism	Motion - energy flow	Motion	Energy flow in technological systems
Radioactivity			
Earth forces	Weather dynamics	Weather dynamics	Energy flow in global systems

Summary of Science Teacher Questionnaire for Curriculum Review

This Science curriculum review questionnaire was carried out as part of the Curriculum Cycle for the Integrated Resource Package (IRP) review. Educators in British Columbia who teach Science were invited to answer a Science curriculum review questionnaire. This questionnaire was used to determine what is happening with Science in BC schools as well as gain feedback on the IRP structure.

Time Line for the Questionnaire

Questionnaire distribution -	November, 2000
Questionnaire collection -	December 15, 2000 was the return date, however, responses received until January 24, 2001 were included in this analysis.
Data Analysis -	December 2000 - January, 2001
Summary Report -	February 2001

Questionnaire Distribution

- directly to 160 teachers who attended the October 20, 2000 Science in BC Day held at Stelly's School in Saanich
- mailed to every school in the province to the attention of the Science Department Head or the Science Contact Teacher with an introductory letter and a copy of the questionnaire to be photocopied for Science educators (K-7 -1727 in English and 149 in French; 8 - 12 - 696 in English and 80 in French)
- mailed to every School District Superintendent with introductory letter (K-7 - 61 in English and 33 in French; 8-12 - 61 in English and 33 in French)
- posted on the "What's New" Page of the Curriculum Branch Website in English and French
- advertised in the December BC ED News and the Momentum BCScTA Newsletter
- distributed via e-mail distribution lists (BCTF Science Teachers' PSA, Environmental Educators PSA and the Professional Development listserve)
- distributed via e-mail to Science teachers
- distributed via e-mail to Field Services Coordinators

Questionnaires

There were two questionnaires, K-7 and 8-12. Both questionnaires had an identical first page that included 9 questions relating to teacher demographics and general IRP questions. The K-7 questionnaire included 17 questions and the 8 - 12 questionnaire had 14 questions. The questionnaire objectives were to determine:

- the usefulness of the different components of the IRPs
- the preferred IRP versions (print, CD-Rom or Web)
- the amount of time Science is taught in K-7 classrooms
- the appropriateness of the Prescribed Learning Outcomes (PLOs)
- the principal learning resources used by educators
- the factors that determine the content of Science teaching
- the use of information and communication technology in Science teaching
- the barriers that hinder the implementation of the school Science program
- the familiarity with the Ministry of Education Safety Manual
- the integration or lack of aboriginal content in Science

The information from the questionnaires was entered into a comprehensive database and then analyzed to identify any patterns and trends. Some of the responses are displayed graphically to assist in the analysis. Similarities and differences among the answers were identified and a synthesis of common responses is provided.

Analysis of Questionnaire Results

Demographics of Questionnaire Respondents

Respondents were requested to indicate; their current teaching assignment, how many years they have been teaching, in which school district they teach, in what type of school they teach and the size of the school. The following tables and graphs display the results of this information.

Distribution of Returned Questionnaires

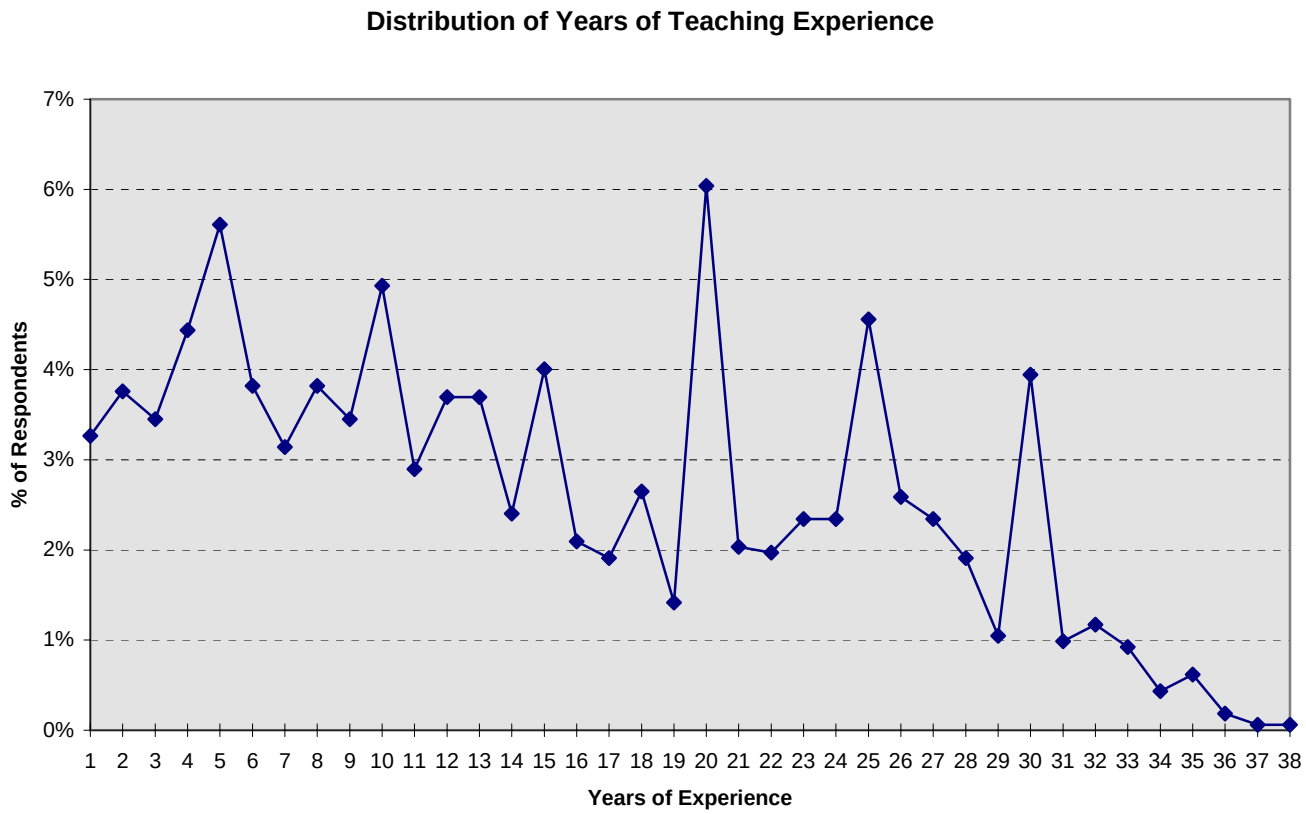
School District	K-7 respondents	8-12 respondents	Total
5 - Southeast Kootenay	11	5	16
6 - Rocky Mountain	14	4	18
8 - Kootenay Lack	14	12	26
10 - Arrow Lakes		1	1
19 - Revelstoke	2		2
20 - Kootenay - Columbia	7	4	11
22 - Vernon	13	6	19
23 - Central Okanagan	136	10	146
27 - Cariboo-Chilcotin	13	3	16
28 - Quesnel	10		10
33 - Chilliwack	18	1	19
34 - Abbotsford	13	3	16
35 - Langley	23	11	34
36 - Surrey	85	30	115
37 - Delta	54	8	62
38 - Richmond	34	15	49
39 - Vancouver	50	22	72
40 - New Westminster	4	6	10
41 - Burnaby	12	41	53
42 - Maple Ridge - Pitt Meadows	42	15	57
43 - Coquitlam	64	13	77
44 - North Vancouver	25		25
45 - West Vancouver	5	1	6
46 - Sunshine Coast	6	6	12
47 - Powell River	3	4	7
48 - Howe Sound	9	4	13
49 - Central Coast	2		2
50 - Haida Gwaii/Queen Charlotte	1	1	2
51 - Boundary	2		2
52 - Prince Rupert	6	2	8
53 - Okanagan Similkameen	8	1	9
54 - Bulkley Valley	12	5	17
57 - Prince George	28	10	38
58 - Nicola-Similkameen	9	1	10
59 - Peace River South	19	7	26
60 - Peace River North	8		8

School District	K-7 respondents	8-12 respondents	Total
61 - Greater Victoria	26	6	32
62 - Sooke	5	2	7
63 - Saanich	10	5	15
64 - Gulf Islands	3		3
67 - Okanagan Skaha	7	8	15
68 - Nanaimo - Ladysmith	22	12	34
69 - Qualicum	20	7	27
70 - Alberni	9	4	13
71 - Comox Valley	17	7	24
72 - Campbell River	11	5	16
73 - Kamloops/Thompson	48	18	66
74 - Gold Trail	7	5	12
75 - Mission	9	1	10
78 - Fraser-Cascade	1		1
79 - Cowichan Valley	15	3	18
81 - Fort Nelson	3		3
82 - Coast Mountains	15	2	17
83 - North Okanagan-Shuswap	20	5	25
84 - Vancouver Island West	6	1	7
85 - Vancouver Island North	2	1	3
87 - Stikine	2	1	3
91 - Nechako Lakes	14	7	21
92 - Nisga'a			0
93 - Francophone Education Authority	12	2	14
Independent Schools	172	63	235
No School District named	14	12	26
Total	**1259**	**402**	**1661**

There were 1394 respondents who indicated that they taught in a Public School, 235 in Independent Schools and 4 in First Nations Schools.

Teaching Experience

The number of years of teaching experience amongst the questionnaire respondents ranged from a few months to 38 years with a mean of 14.9 years of teaching experience.



Size of School

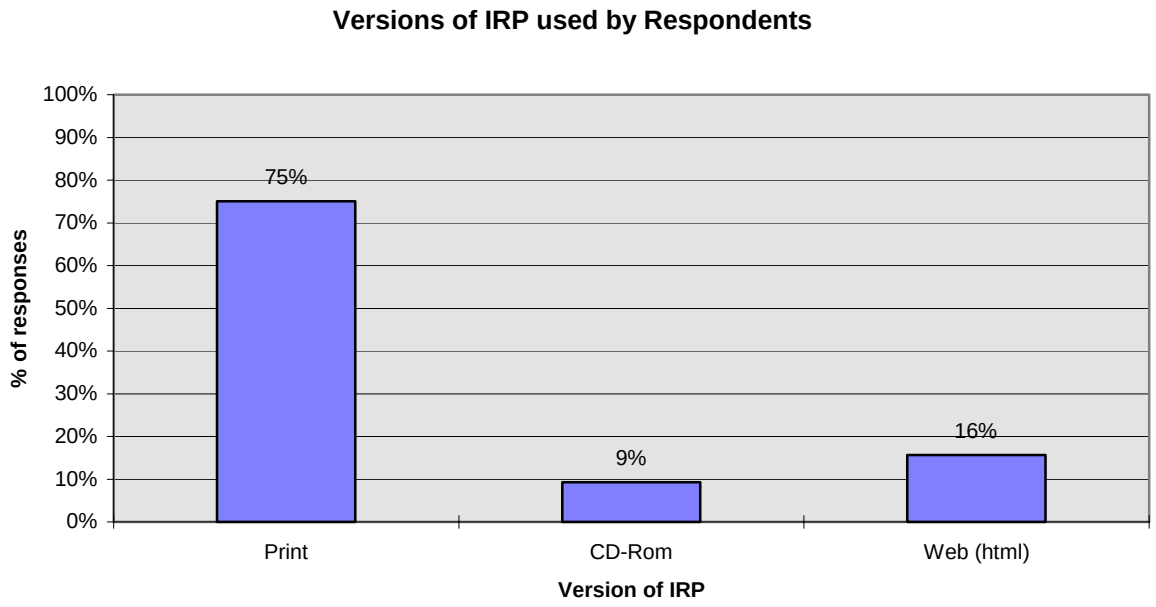
Respondents were asked to indicate the size of the school where they worked. The majority teach in medium sized schools of 101 to 500 students.

Size of School	% of respondents
Small (less than 100 students)	7%
Medium (101 to 500 students)	68%
Large (over 500 students)	26%

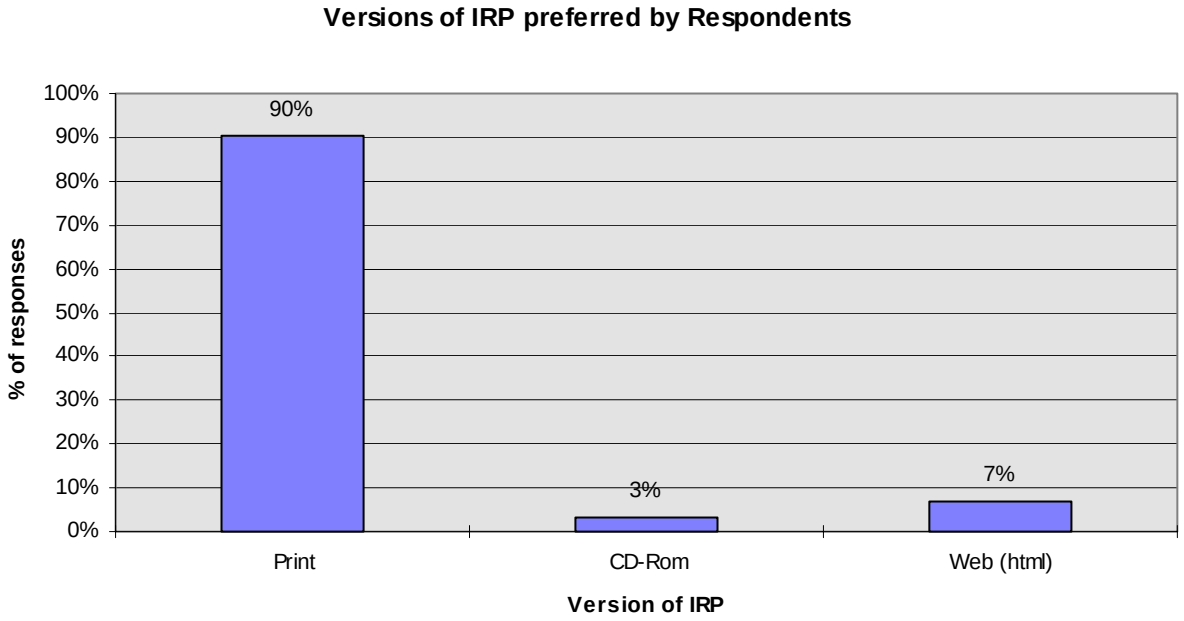
Analysis of General IRP Questions

Respondents were asked to indicate the IRP versions (print, CD-Rom and Web (html)) that they have used and the version of the IRP that they prefer to use. There was overwhelming response for the print version of the IRP as indicated in the graphs below.

Version of IRP that is most used



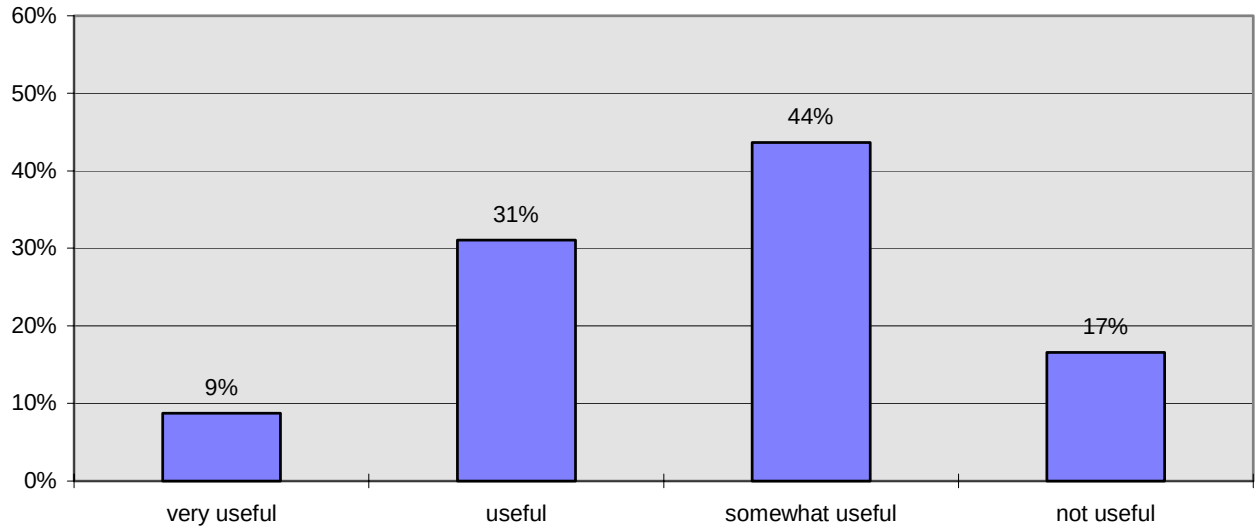
Version of IRP that is preferred



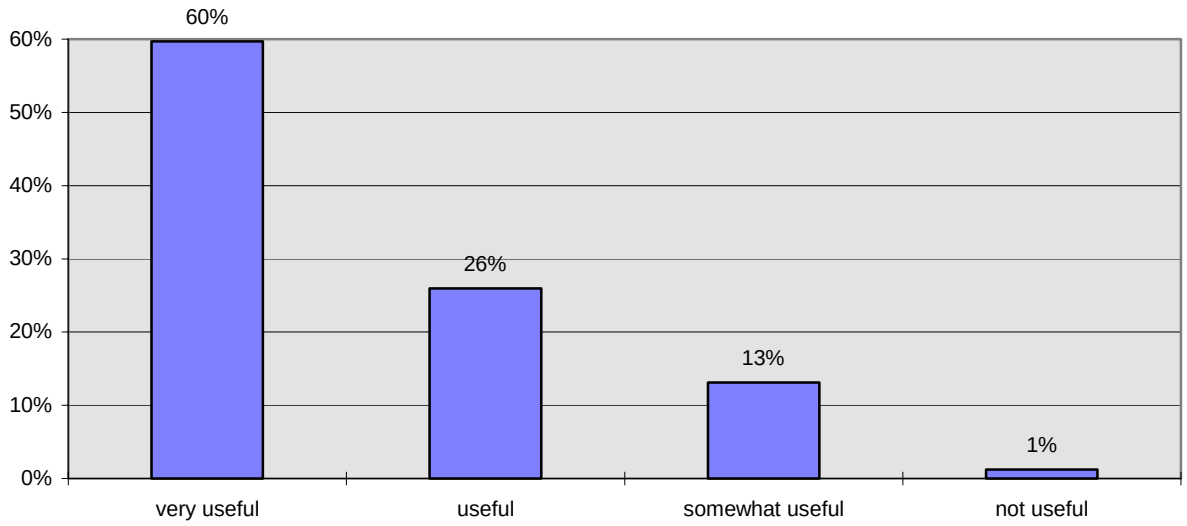
Rating of IRP Components

Respondents were asked to rate the different components of the IRP. Findings show that Appendix A, which lists the prescribed learning outcomes, is rated as the most useful (86%) component of the IRP. 71% of respondents indicated that they find the main body of the IRP very useful/useful. The introduction to the IRP and Appendix B and D received similar ratings for the usefulness. Appendix C which contains cross-curricular interests received the highest "not useful" rating of 27%. It has already been decided that Appendix C will not be included in future IRP revisions.

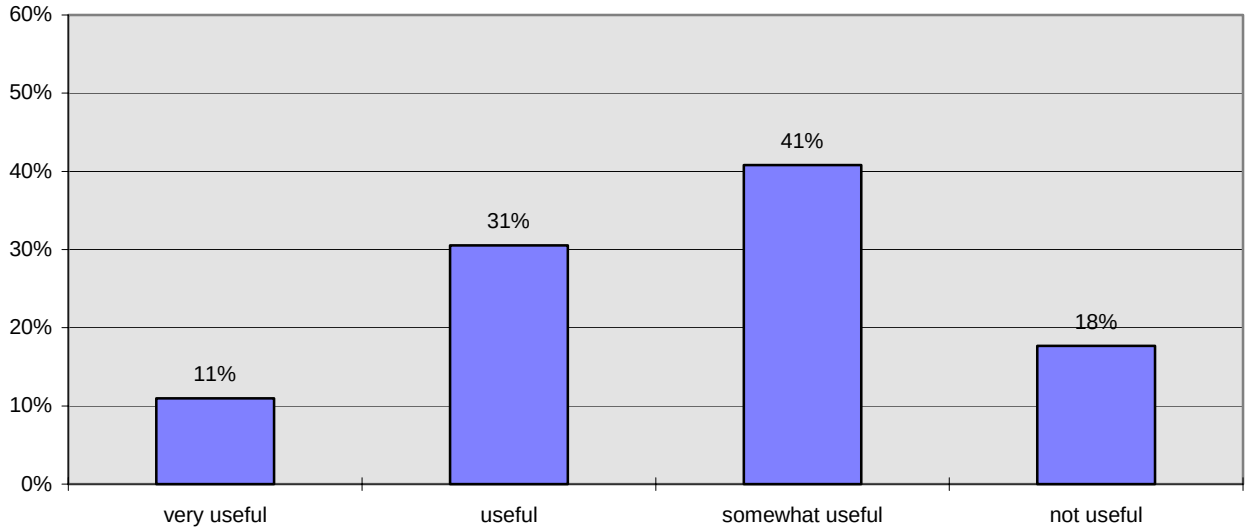
Rating of Introduction, including philosopy, rationale, content overview



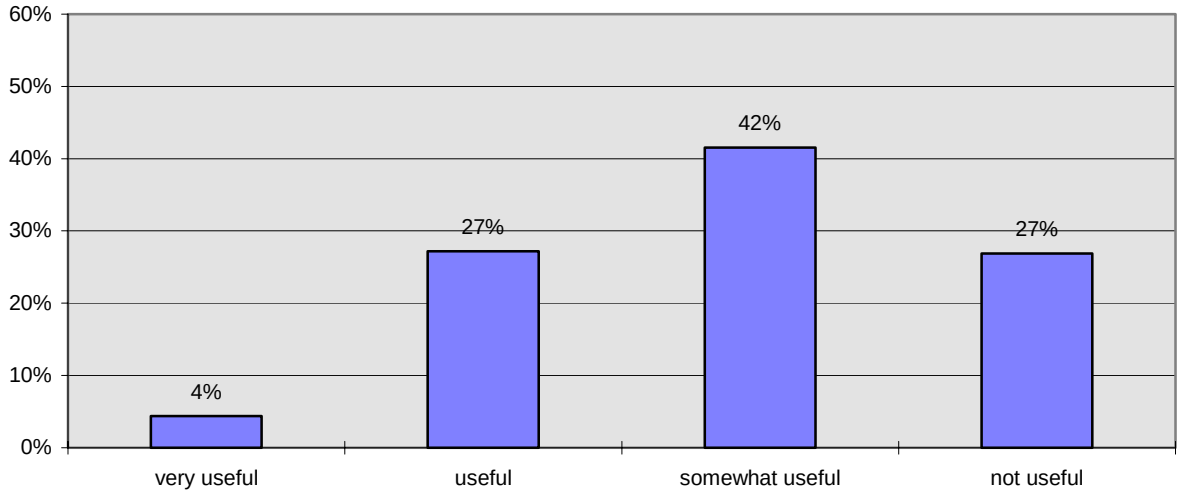
Rating of Appendix A - Prescribed Learning Outcomes



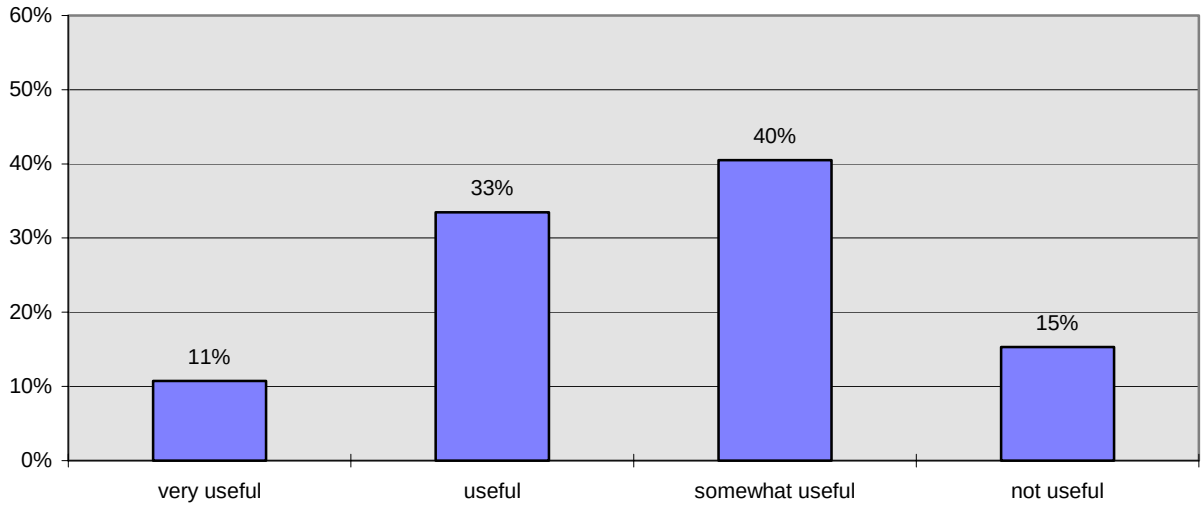
Rating of Appendix B - Learning Resources and Grade Collection Information



Rating of Appendix C - Cross-Curricular Interests



Rating of Appendix D - Assessment and Evaluation

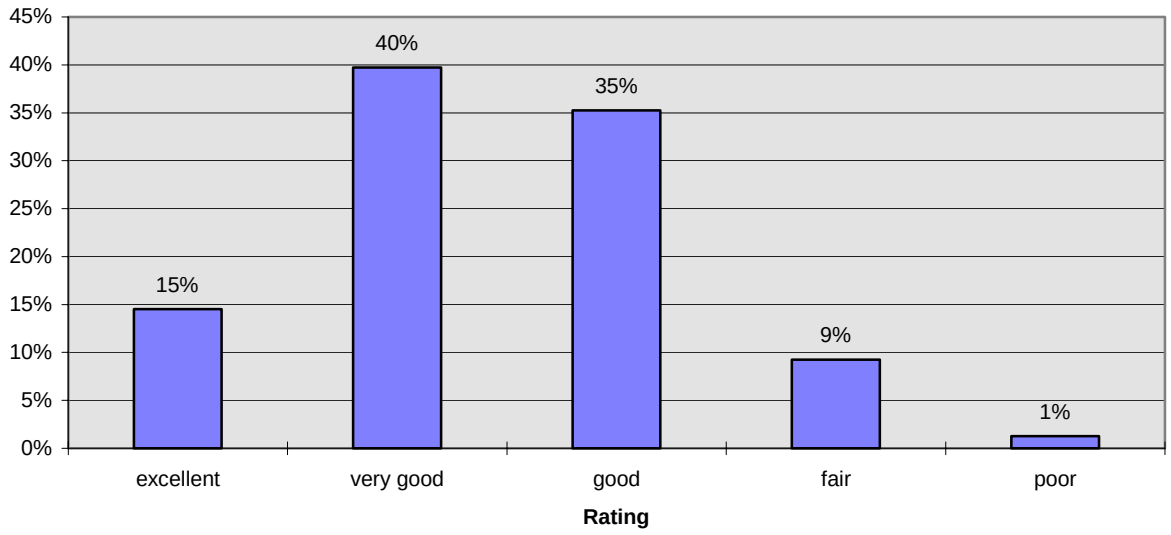


Some respondents to the K-7 questionnaire noted that Appendix F (Topic Chart) was very useful.

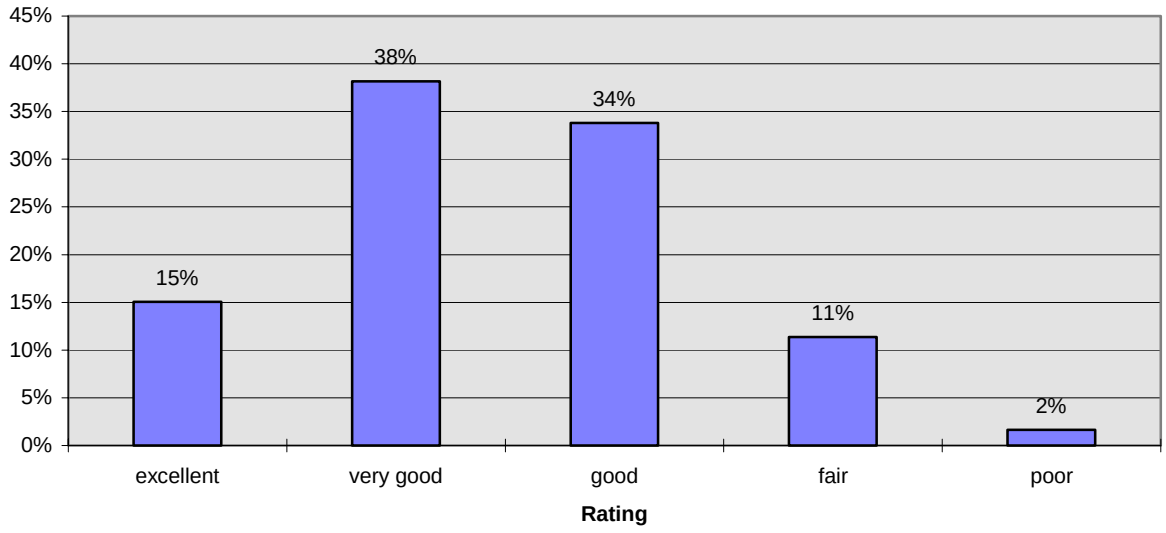
Results of how respondents rated the following elements of the IRPs

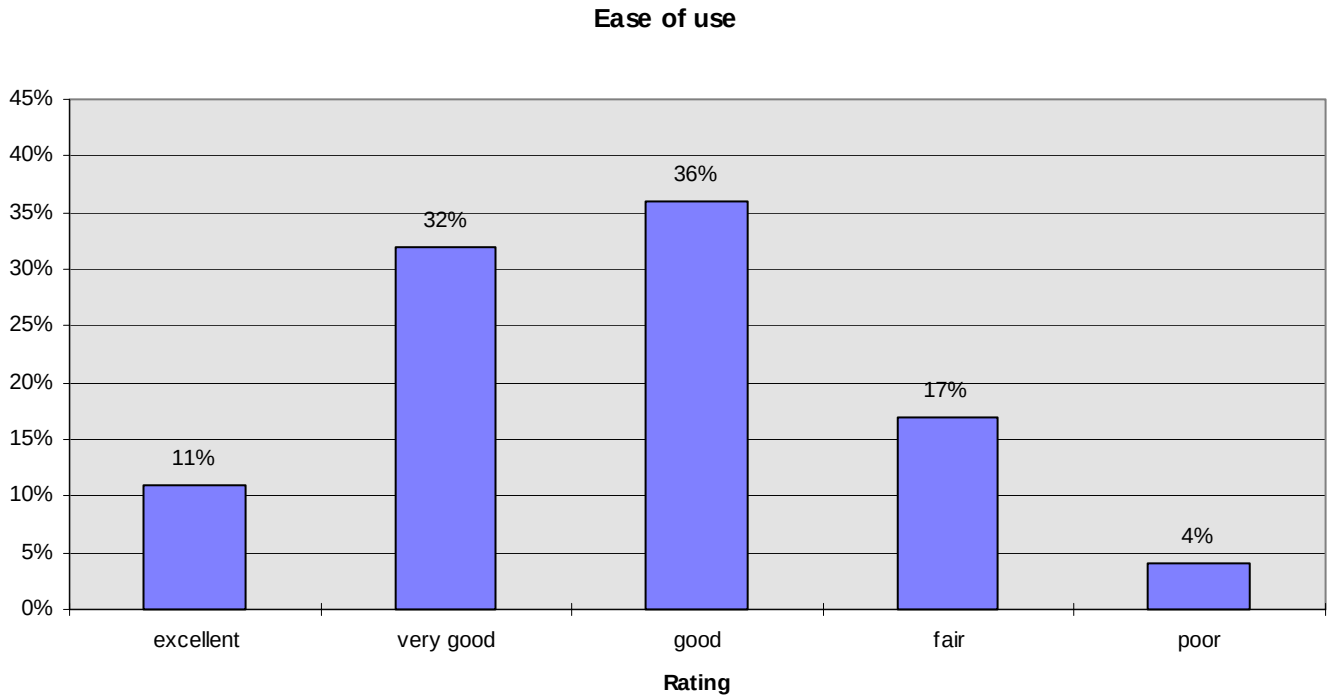
The graphs included below indicate how respondents rated different elements of the IRPs. There appears to be general consensus among respondents with respect to the organization of the content, the readability of the IRPs and the design. Respondents were not as satisfied with the ease of use and the currency of the IRPs.

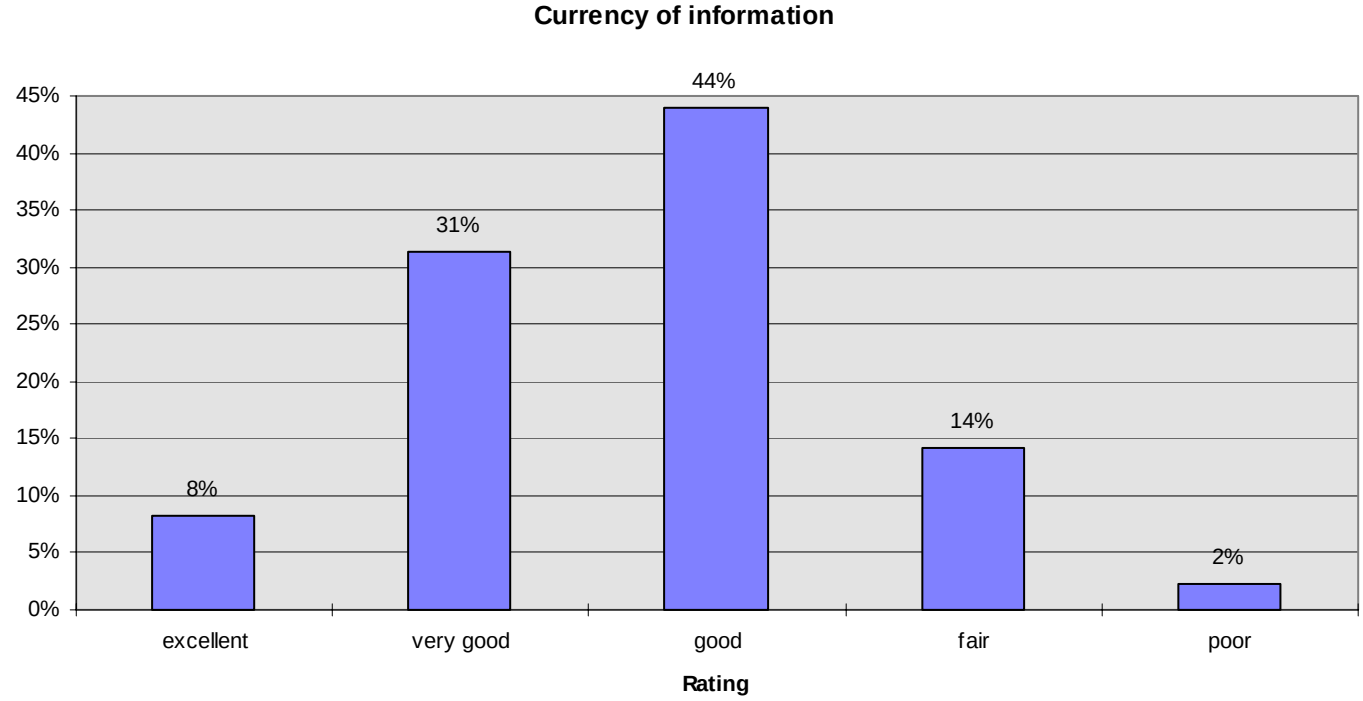
Organization of content

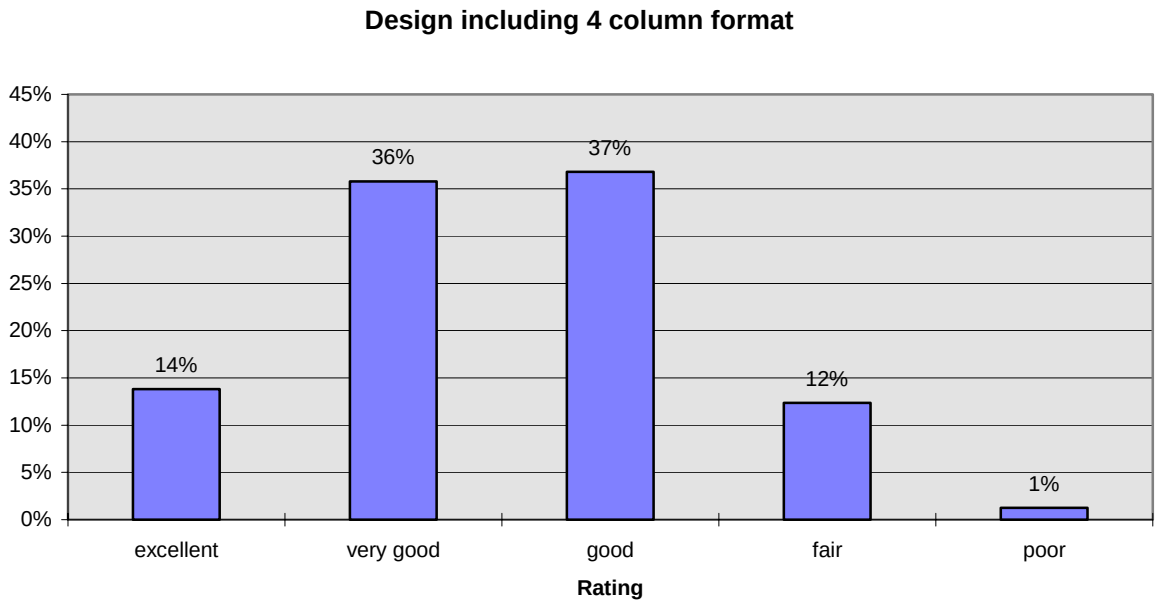


Readability




Ease of use
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
11%
32%
36%
17%
4%
excellent
very good
good
fair
poor
Rating


Currency of information
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
8%
31%
44%
14%
2%
excellent
very good
good
fair
poor
Rating

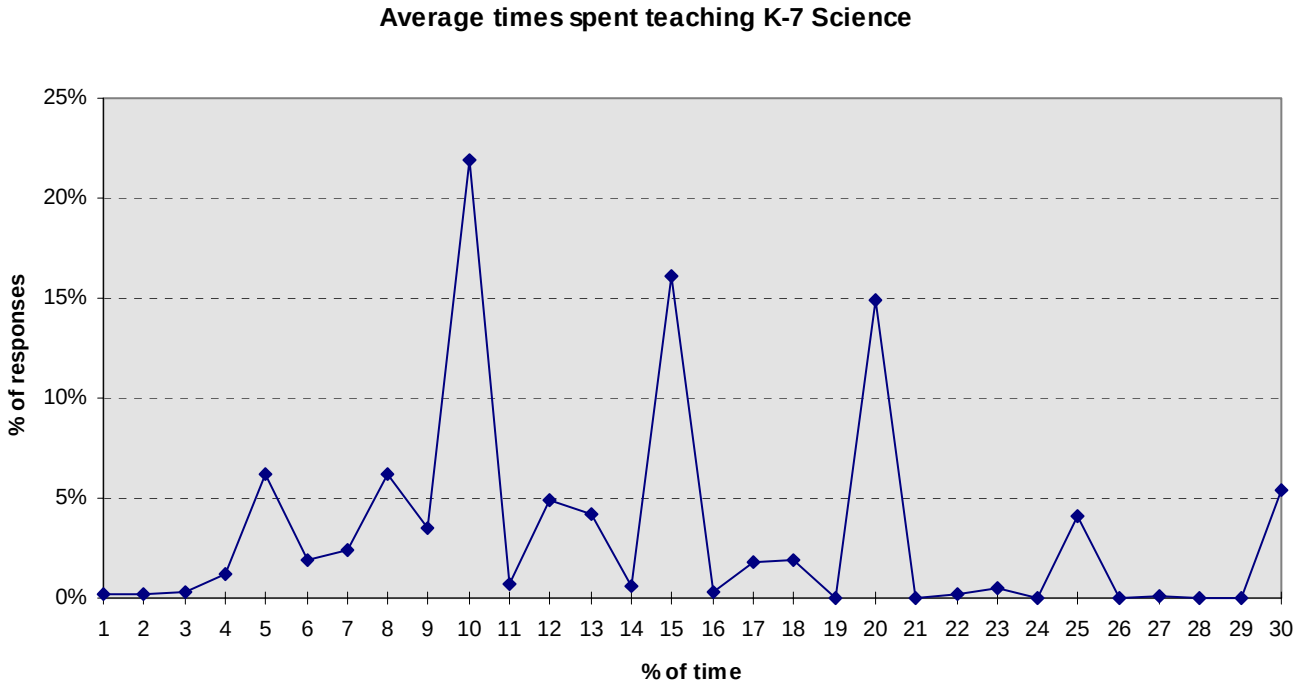

Design including 4 column format
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
14%
36%
37%
12%
1%
excellent
very good
good
fair
poor
Rating

SCIENCE RELATED IRP QUESTIONS FOR K-7

The following is an analysis of the responses made by the 1259 K-7 Science educators who responded to the K-7 IRP curriculum review questionnaire.

Percentage of time spent teaching Science during the school year

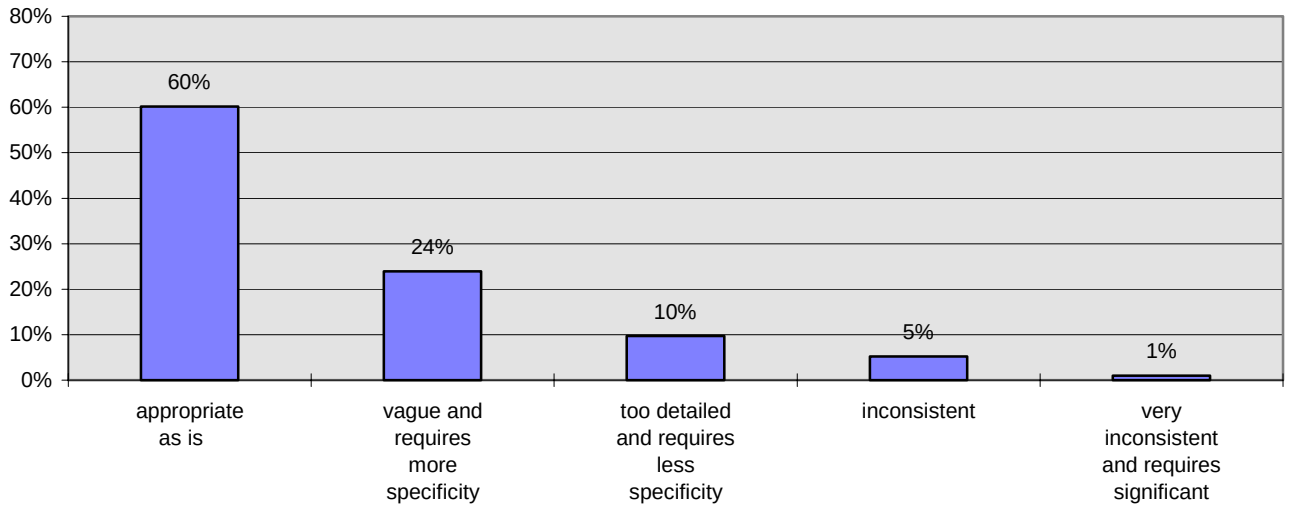
The recommended time allotments for Mathematics, Science and ICT is 30% for Grades 4 to 7. In Kindergarten to Grade 3 the time spent teaching science is left to the teacher's discretion. There are 950 hours in the school year for Grades 1 to 7 students. Therefore, the amount of time that is recommended for Math, Science and ICT is 285 hours. Teachers indicated that they spend an average of 13.5% of instructional time teaching Science and the most common response to this question was 10 % of instructional time.



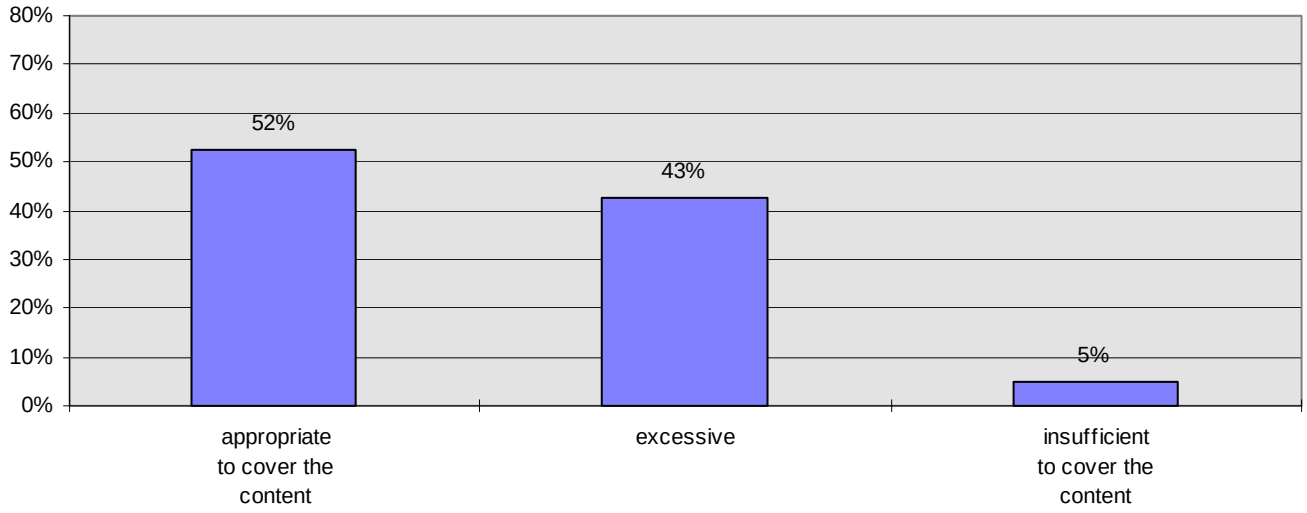
Rating of the PLOs for the K-7 Science IRP

- A small majority of respondents (60%) indicated that the wording of the current PLOs is appropriate.
- Only half of the K-7 (52%) teachers thought that the PLOs are appropriate to cover the content.
- 43% felt that there are too many PLOs.
- The majority of respondents use the IRPs to guide their lesson planning.
- 85% (10% strongly agree and 75% agree) of respondents felt that the PLOs are grade appropriate.

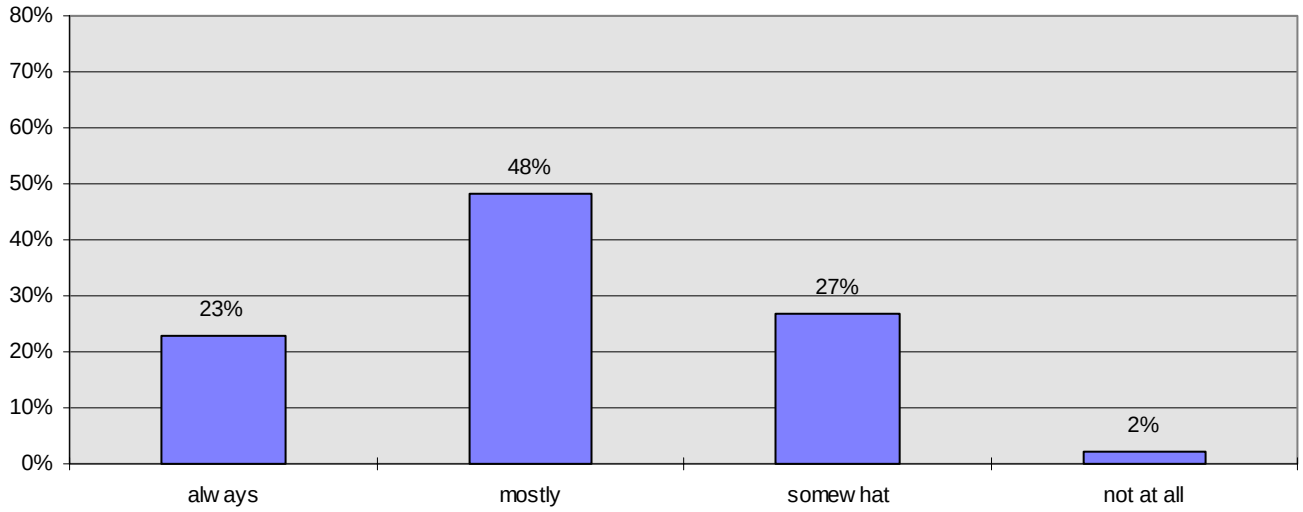
Science K-7 - Wording of PLOs



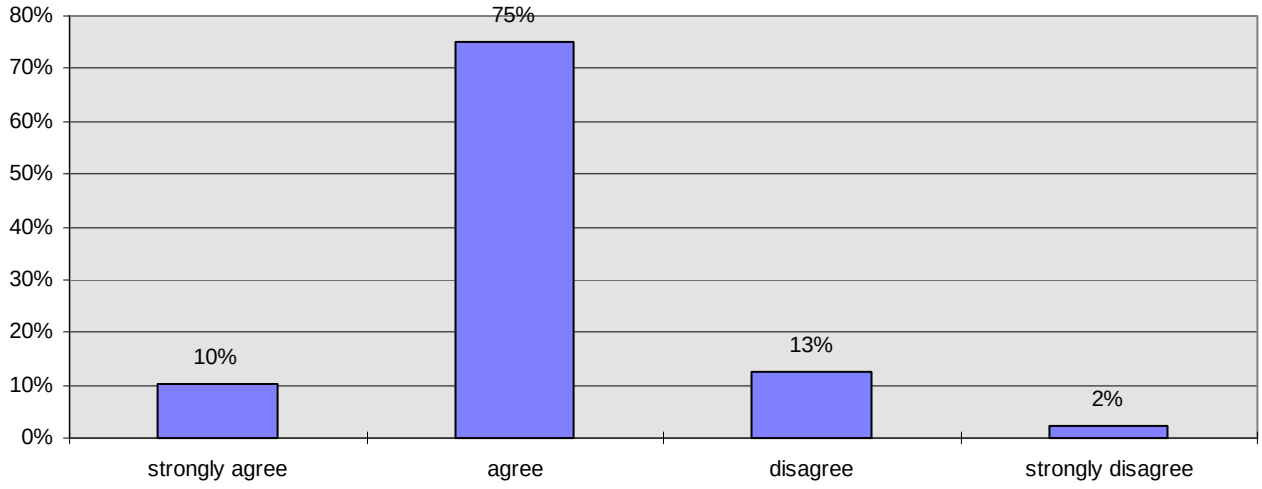
Science K-7 - Number of PLOs



Science K-7 - Use of PLOs for lesson planning



Science K-7 - Grade appropriateness of PLOs



Common Comments about PLOs

- the IRP is a useful guide for planning and is well written in comparison to other K-7 IRPs
- separate the K/1 and 2/3 PLOs into separate grades
- create PLOs for combined/ multi-grade classes as it is difficult to teach all of the PLOs for the different levels
- separate the PLOs by grade not subject
- write PLOs for ESL students and those with varying degrees of ability/development
- too many PLOs and too many IRPs at the K-7 level
- reduce the number of topics and therefore the number of PLOs
- some PLOs are too specific while others are too broad/vague
- PLOs seem very diverse and not sequenced into steps to gain a deeper understanding of their respective topics
- need to be worded so that everyone, parents included, is able to read and understand
- without the suggested instructional strategies, some of the PLOs are difficult to interpret
- good degree of flexibility with the PLOs

Common suggest topics of study that could be changed/added/deleted from Grade/IRP.

Of all of the respondents to this IRP, 32 % felt that changes should be made to the IRP.

Most common suggested changes/additions/deletions for the K-7 Science IRP.

Grade	Common suggestions for changes
K/1	• states of matter is not grade/age appropriate • reduce the number of topics to teach (especially physical Sciences)
2/3	• delete earth's composition as it is not interesting for grade 2/3 • delete energy in our lives as it is too abstract and little meaning at this age level • divide the PLOs for each grade and reduce the number of PLOs • hearing and speech are difficult to teach. Suggest an easier body system. • increase environmental studies • properties of matter is not age appropriate as it is too abstract
4	• reduce the number of topics • include electricity at a higher grade (ex Gr. 6) • some body systems are too difficult
5	• lack of resources to do hands-on Science • there is overlap of topics with the social studies' PLOs (Materials in Our World/BC Living Resources/Natural Resources) • vague PLOs for Materials in Our World • Light and Colour is not age appropriate
6	• do not have resources/equipment to teach Microscopic World • reduce the number of PLOs/topics for greater depth and understanding
7	• not enough hands-on topics • too many topics to teach in-depth • ecology unit is repeated in Science 8 (ex biomes) • reproduction is not age appropriate • astronomy is done in Gr. 6 • need a unit about the ocean

Principle Learning Resources for K-7 Science

The majority of K-7 Science educators reported that the principle learning resources that they use are "teacher prepared" using such sources as the library, the internet and resources bought (often using their own money) from teacher stores.

Most common resources used by K-7 Science educators

- *AIMS Activities - Spectrum Educational Supplies Ltd.
- BC Mining - BC Mining Association
- *BC - Its Land, Minerals and Water Resources - Pacific Edge Publishing
- *Discovery Works Modules for BC - Prentice Hall Ginn
- Engaging Science
- Explorations in Science - Addison-Wesley Publishers Ltd.
- Eyewitness books -Irwin Publishing
- Focus on Science
- *FOSS Modules - Britannica Science System
- Innovations in Science - Harcourt Brace and Company Canada Ltd
- Journeys in Science
- Kinetic Connections - BC Hydro
- Magic School Bus books and videos - Scholastic Big Books
- *Nelson Science - Nelson Canada
- Pleins Feux sur les Sciences
- Project Wild - Ministry of Environment, Lands and Parks
- Rainbow Horizons Units
- *Salmonids in the Classroom - BCTF Lesson Aids Service
- Scholastic Science Kits
- School District #23 Science Units
- Sciences en marche - Maxwell MacMillan Canada Inc.
- Science Interactions - McGraw-Hill Ryerson Ltd.
- Science is… - Scholastic Canada Ltd
- *Science Probe 7 - Nelson Canada
- STEM

Note: Resources indicated with an asterisk (*) are currently in the K-7 Science Grade Collection. The majority of the other resources are listed in Appendix B - Learning Resources of the Science K-7 IRP.

Grade Collections

Teachers have requested that the Ministry identify a collection of resources for each grade level in order to provide guidance to schools for establishing relevant and comprehensive collections for the support of a curriculum or course. The Grade Collections are subsets of the previously recommended resources from the Science K-7 IRP as well as some newly identified resources that most closely match the prescribed learning outcomes. This Grade Collection was first published in 1998 with continual addition of resources.

Web Site for Grade Collections and Newly Recommended Resources
http://www.bced.gov.bc.ca/irp_resources/lr/resource/res_main.htm

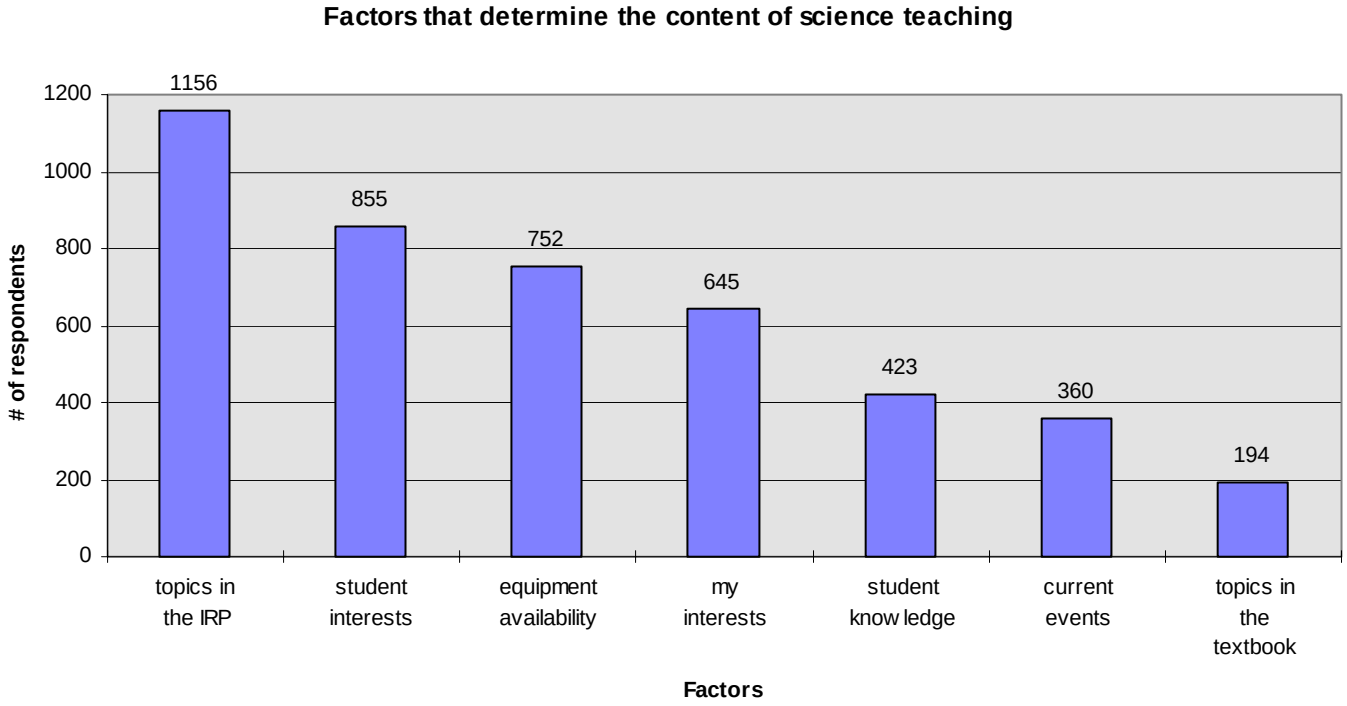
As this is a relatively new document produced by the Ministry of Education, it was of interest to learn how many of the respondents were familiar with the Grade Collections and whether they felt that there are sufficient resources to complement the K-7 Science IRP. Fifty-five percent of respondents indicated that they are familiar with the Grade Collections. However, only 41% of respondents felt that there are sufficient learning resources to complement the course.

Common statements regarding the lack of sufficient learning resources

- lack of funding available to purchase learning resources
- learning resources are expensive
- need a comprehensive readable textbook
- schools are often lacking in materials and learning resources
- often learning resources are not readily available or out of date
- lack of French learning resources
- often use own money to buy learning resources (especially K-7 teachers)
- As one respondent summed it all up - “it is actual stuff and money we need, not lists!”

Factors that determine the content of Science teaching in K-7 Science

Respondents were asked to indicate, what factors, from a list of seven, determine the content of their Science teaching. The most common response was 'topics in the IRP' followed by 'student interests', 'equipment availability' and 'teacher interests'.

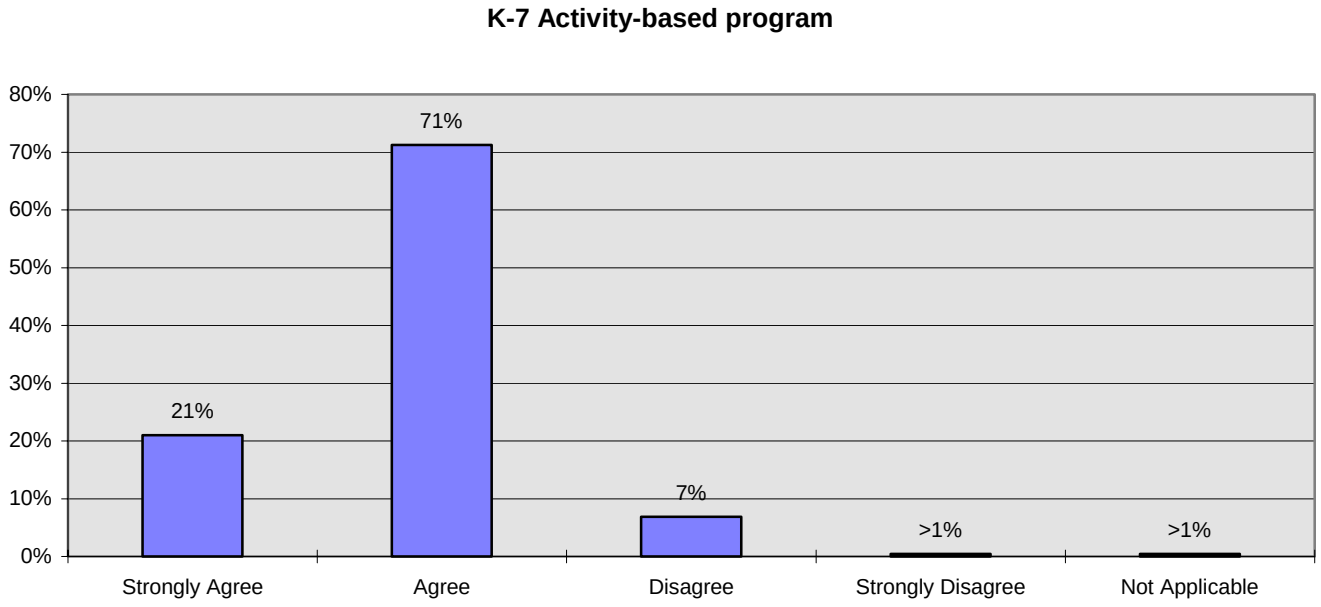


Other factors mentioned by respondents that determine the content of Science teaching at the K-7 level are:

- field trip opportunities
- integration with other subjects
- local issues
- availability of learning resources
- school-based Science plan
- time considerations.

Activity-based K-7 Science Program

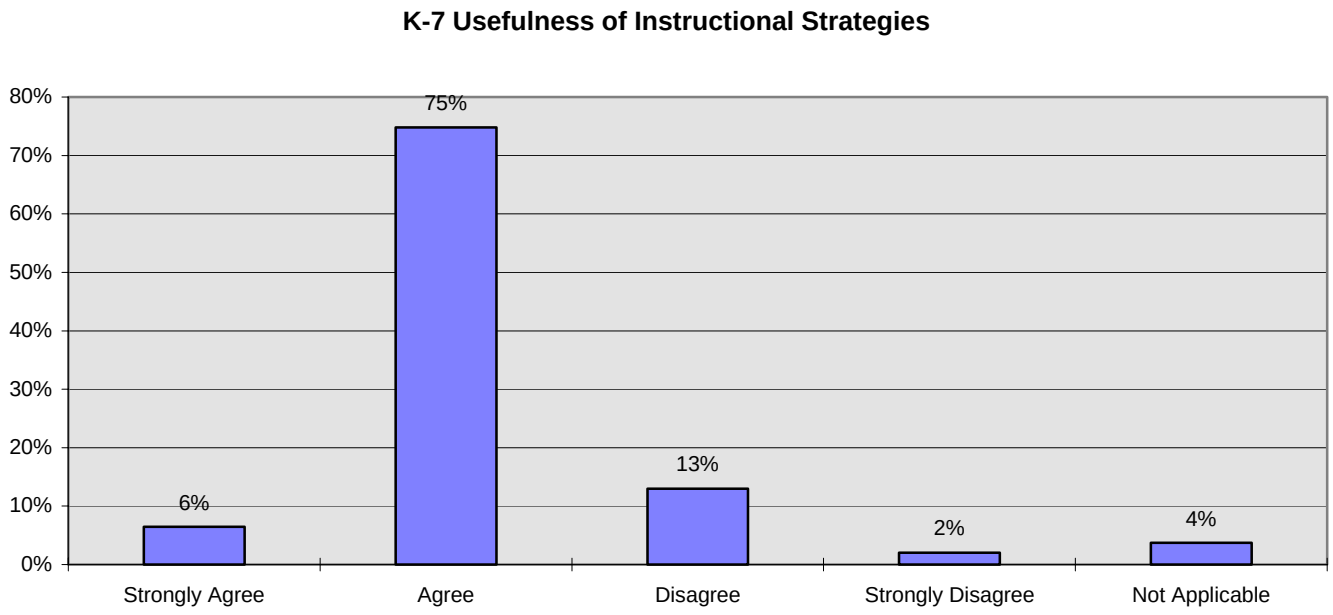
The literature shows that a Science program that is activity based is more meaningful for students and better learning often occurs. The following shows how K-7 teachers rate their Science program as being activity-based. It is encouraging to note that 92% of respondents said that they agree/strongly agree with this approach to teaching Science. Factors mentioned by respondents that limit the amount of activity-based learning taking place in their Science programs are; the availability of equipment and learning resources, the topic being taught and the amount of time available to prepare hands-on activities.



Usefulness of Instructional Strategies in K-7 Science IRP

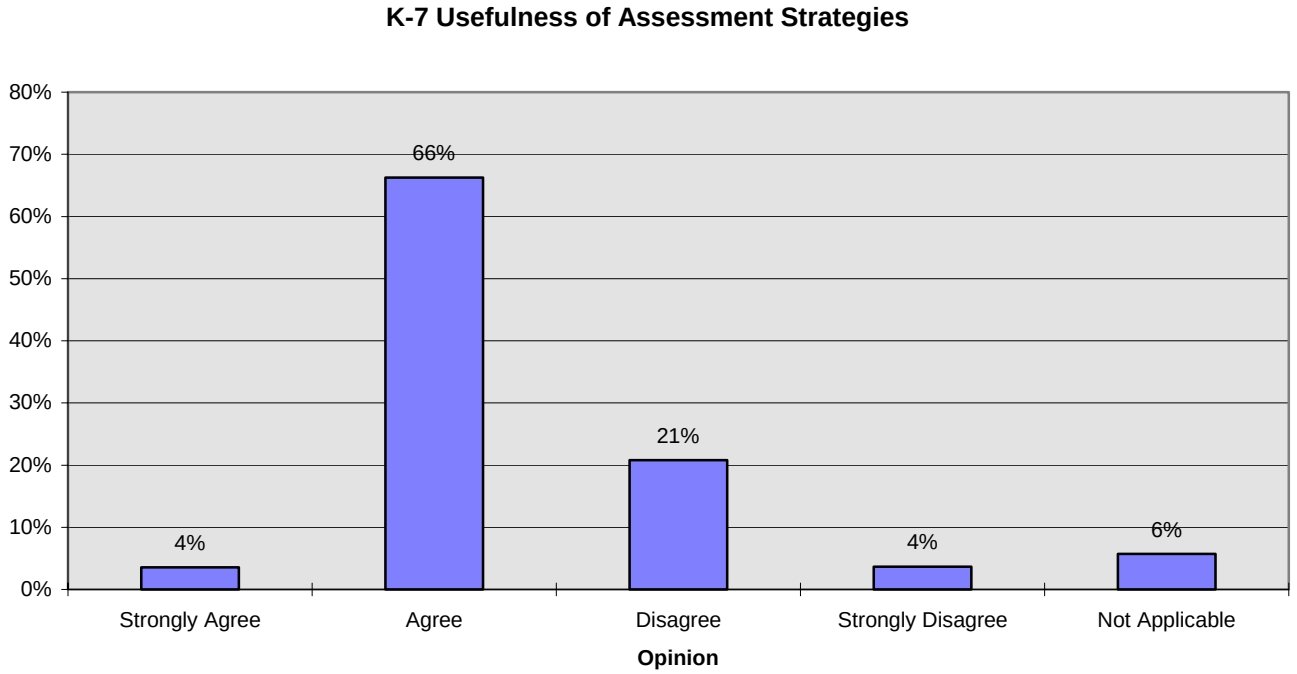
Educators responding to the questionnaire were asked to comment on the usefulness of the instructional strategies that are included in Column 2 of the K-7 Science IRP. 81% strongly agree and agree that they are useful. Four percent of respondents answered 'not applicable' which may indicate that they have not read or used the instructional strategies. Some comments made about the instructional strategies include:

- some are not practical without the necessary resources
- there should be more suggested strategies
- they help to clarify the PLOs
- the ideas are good and help to trigger other ideas
- some are very good while others are beyond the scope of student ability and classroom capabilities
- they are helpful for beginning teachers.



Usefulness of Assessment Strategies

Although 69% of respondents agree/strongly agree that the assessment strategies are useful, it would appear that the Assessment Strategies are not referred to or used as much as the Instructional Strategies as demonstrated in the previous graph. Some reasons given by respondents include: the assessment strategies are not always practical in a classroom as they are time consuming and experienced teachers often use their own created assessment strategies. However, respondents commented that the assessment strategies are a starting point and are useful to new teachers.

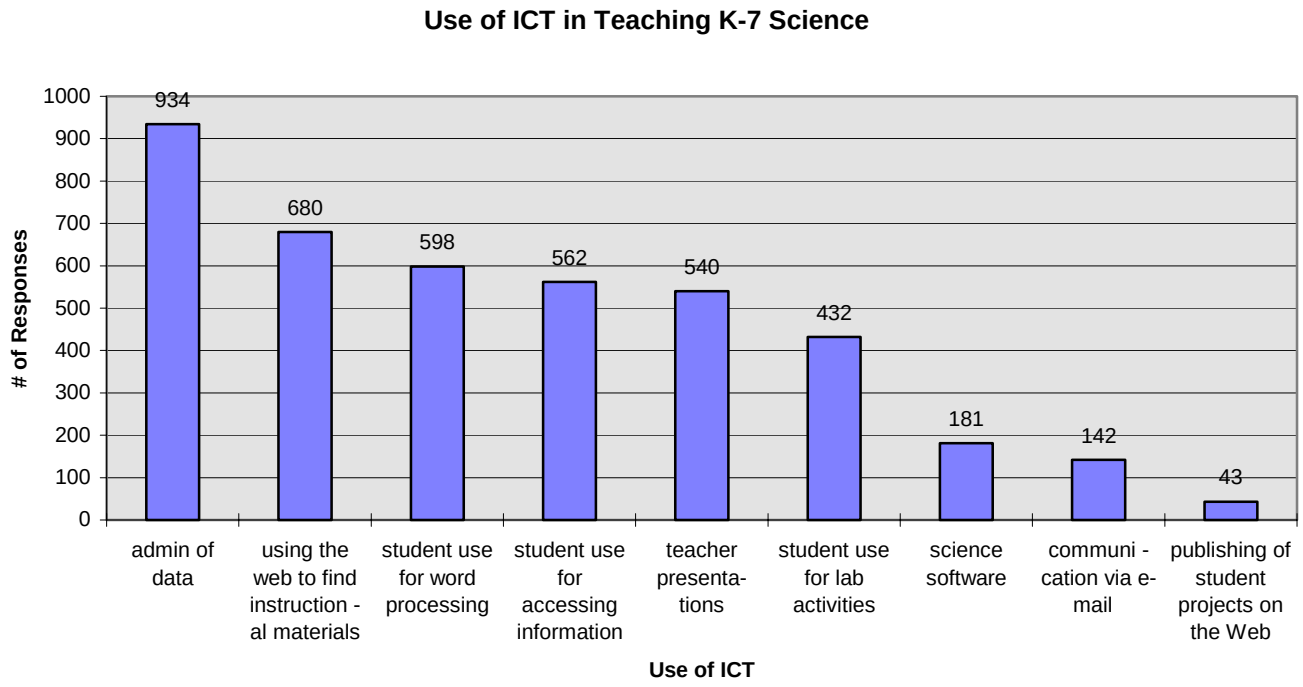


Teaching Science in split/combination Classes

Teaching Science in a split/combination class is a common concern for K-7 educators. Respondents were asked to indicate if they are able to implement all of the PLOs for each grade when they have different grades in the same class. There was an even split to this question between those who said that they managed to implement the PLOs and those who asserted that it was not possible to implement PLOs for multiple grades during the school year. A large number of respondents indicated that they have a school-based two-year plan to teach half of the PLOs one year and half the next year. Some indicated that they choose a couple of units from each grade level to teach during the school year. Many mentioned that it is very difficult to successfully cover all of the PLOs for each grade, especially using an activity-based approach as classtime is a big concern.

Use of ICT in teaching K-7 Science

Respondents were asked to identify the information and communication technology that they use in their teaching. The most common responses were the administration of data such as handout preparation and marks gathering and teachers' use of the web to find instructional materials. Students use ICT for word processing and accessing information for research projects.



The most common software programs used by educators in K-7 Science are:

- CD Roms on various topics such as dinosaurs, earthquakes, volcanoes, animals, planets etc.
- Gizmos and Gadgets
- Magic School Bus Science CDs
- Sammy's Science House

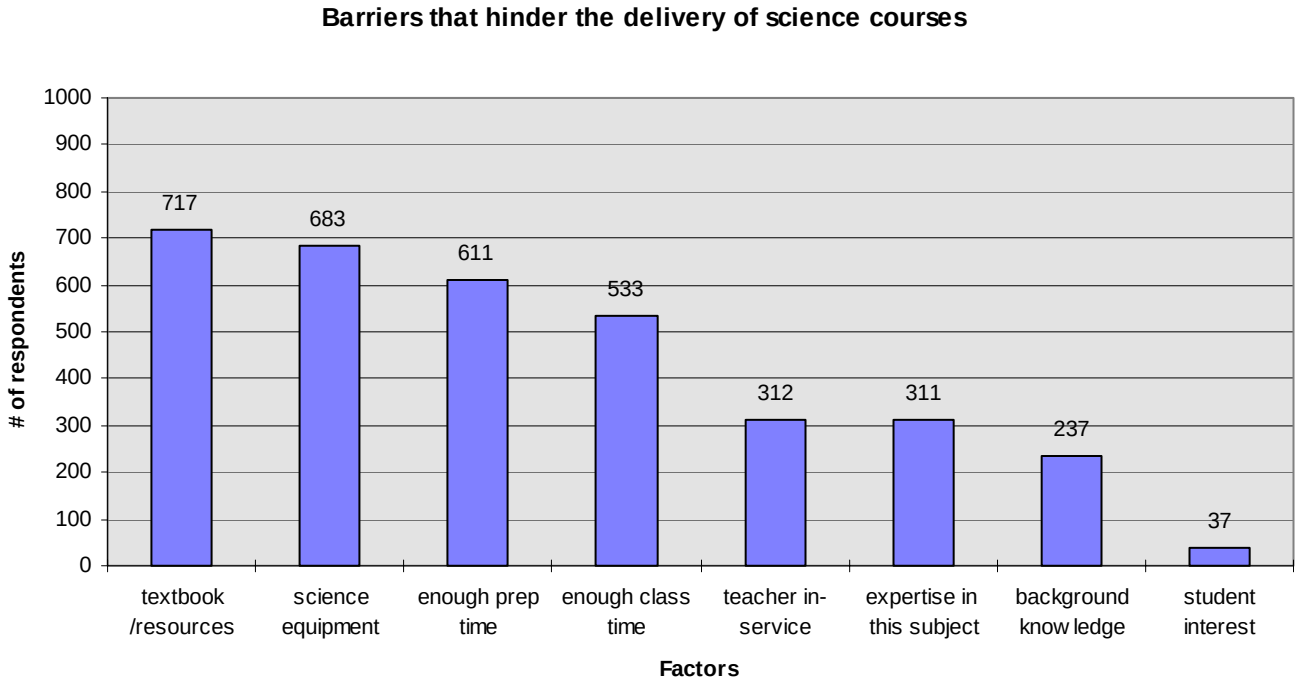
Aboriginal content in Science programs

Respondents were asked to indicate if they integrated Aboriginal content into their Science program. Only 20% indicated that they make reference to Aboriginal content when teaching Science. Many mentioned that they refer to First Nations' use/value of salmon in the salmonids unit. There is also integration when studying plants and animals and the First Nations uses and legends. Aboriginal knowledge is also discussed when studying BC Lands and resources. Some discuss when studying simple machines and First Nations' elders are invited as guest speakers.

When asked what would assist teachers to integrate Aboriginal content in the Science program, respondents suggested that they need more in-service which includes learning resources, knowledge and awareness . Some respondents did not feel that it is necessary/relevant to integrate Aboriginal content into the Science programs.

Barriers that hinder the delivery of K-7 Science courses

Educators were asked to indicate barriers that may hinder the delivery of Science courses for them and/or for their schools. The most common responses are the lack of learning resources and the lack of Science equipment. Time was also mentioned as a concern as there is a lack of preparation time and a lack of class time for course delivery. Other factors mentioned by respondents include: lack of money for resources (consummables and equipment) and field trips and lack of technology.



Ministry of Education Science Safety Manual

The Science Safety Manual was first published in 1988 (reprinted in 1990) and distributed to all schools in the province. It was developed in response to safety needs identified in the Provincial Science Assessments of 1978, 1982 and 1986, as well as concerns identified by various schools districts and the British Columbia Science Teachers' Association. Only 21% of K-7 respondents indicated that they are familiar with the manual. The lack of familiarity with this document raises concerns about the issue of safety in an activity-based Science classroom.

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General Suggestions and Concerns expressed about Science in BC in the K-7 Grades.

Suggestions for the Classroom/ School

- need to make Science more activity-based which requires additional funding for equipment and training
- need to have school Science specialist in charge of school Science equipment
- need for well equipped and readily available lab space and Science equipment storage space
- issue of the "have" and "have not" schools based on fundraising by parents
- need to take advantage of community resources
- need easy access to good learning resources
- improve communication between teachers/feeder schools/other schools in the district/province/country and outside experts

Suggestions for the District

- fund District Science Coordinators
- target more funding for the purchase of Science equipment and supplies as teachers are tired of spending their own money and dealing with a lack of resources
- improve ProD funds and opportunities for teachers to keep up with curriculum and advances in Science
- money to subsidize field trips/guest speakers
- prepare district Science resource kits for each topic/grade
- increase teacher preparation time
- increase the amount of Science learning resources available for teacher to borrow (ex videos and Science kits)

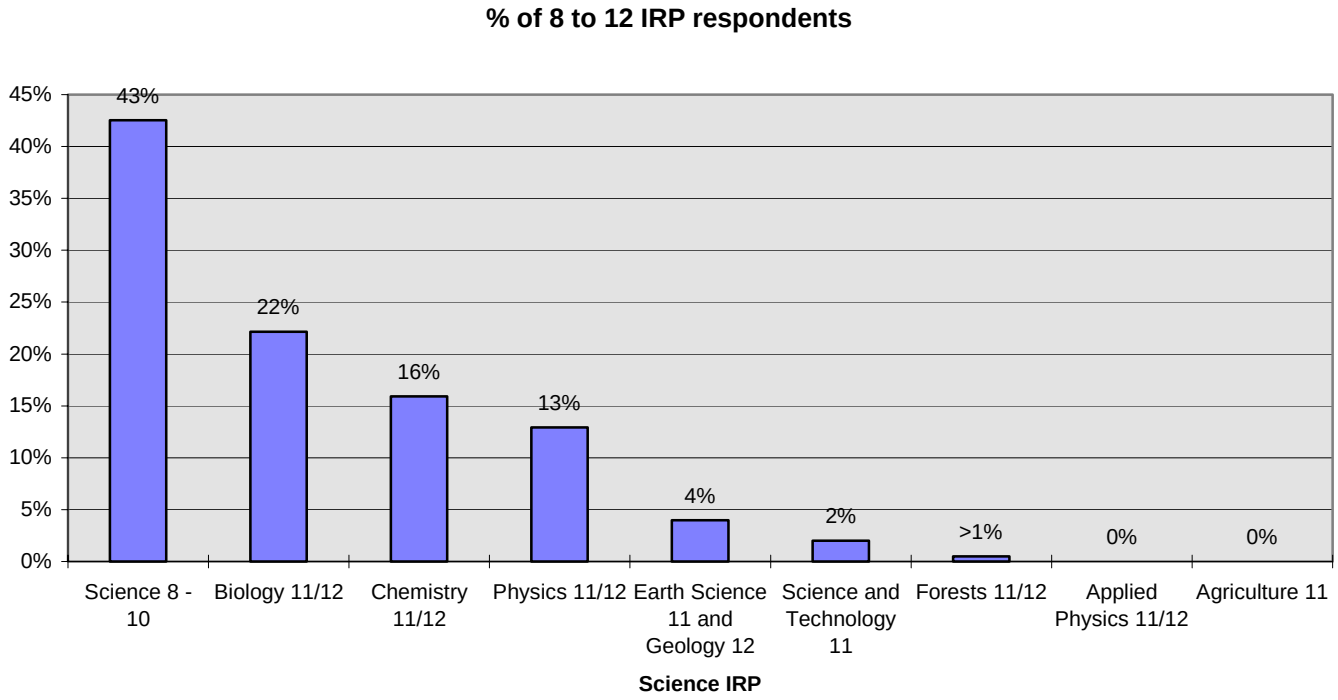
Suggestions for the Ministry

- increase funding for learning resources
- recommend a comprehensive textbook/resource that links directly to PLOs for each grade
- provide in-service to accompany the new IRPs
- create a website that links the PLOs to learning resources and lesson plans of activities
- improve the amount of recommended resources, especially in French
- reduce the number of PLOs/topics to be taught at the K-7 level in all subject areas (depth rather than breadth)
- separate the PLOs for K/1 and 2/3
- avoid overlap of PLOs between subject areas
- provide guidelines on how to address the issue of split/combination classes
- create a more realistic curriculum that recognizes the many tasks already facing teachers and children accompanied by more financial support available to teachers
- communicate what students need to know for secondary school Science
- encourage post-secondary institutions to promote Science in teacher training programs

SCIENCE RELATED IRP QUESTIONS FOR 8-12

Distribution of Respondents to the 8-12 IRP Questionnaire

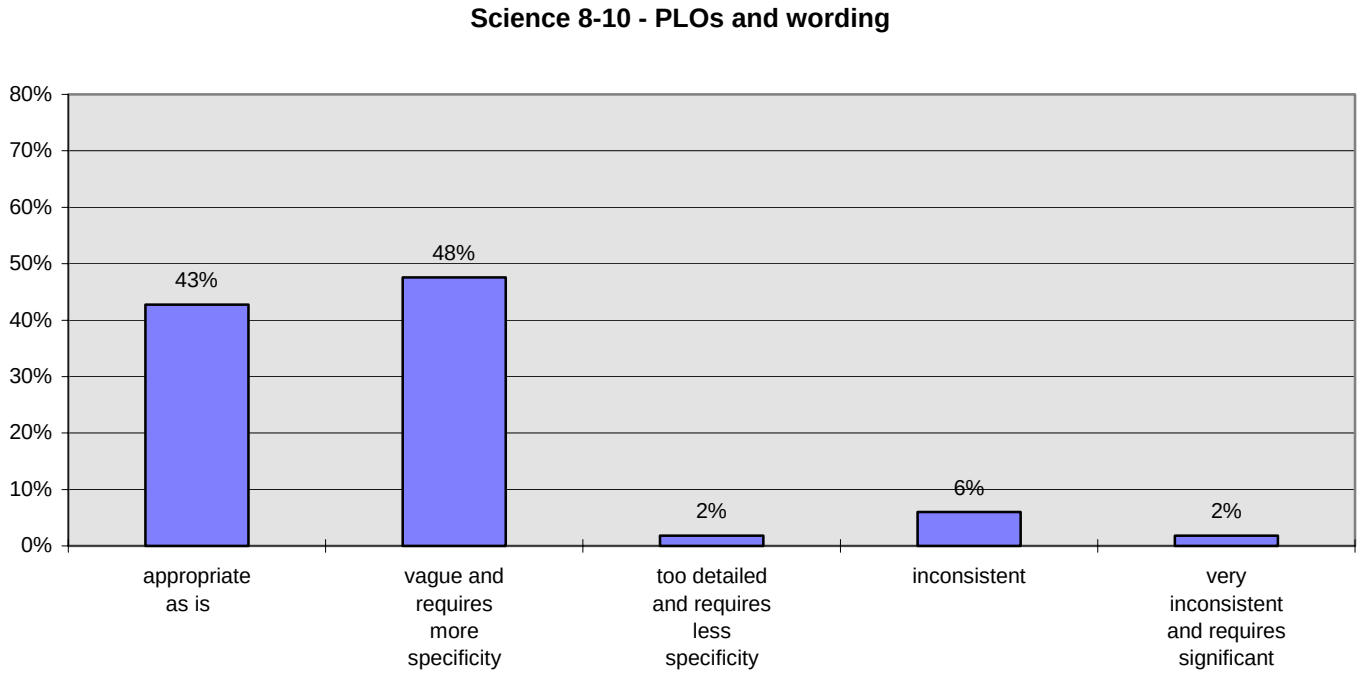
Of the 402 responses to the 8-12 IRP questionnaire, the majority (43%) of the respondents evaluated the Science 8 to 10 IRP. The number of respondents to the other 8-12 Science IRPs reflects the popularity/distribution of these courses in secondary schools throughout the provinces.



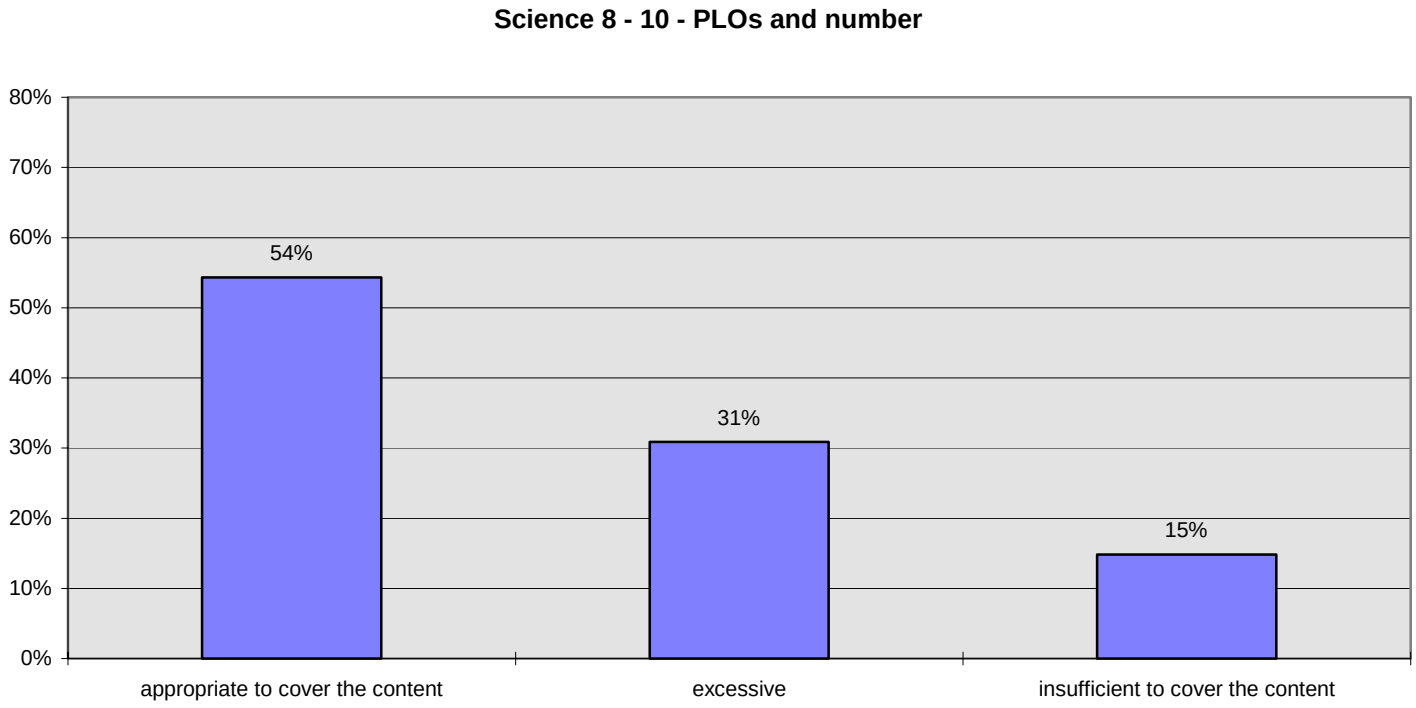
Rating of the PLOs for the 8-12 Science IRPs

Science 8-10 IRP

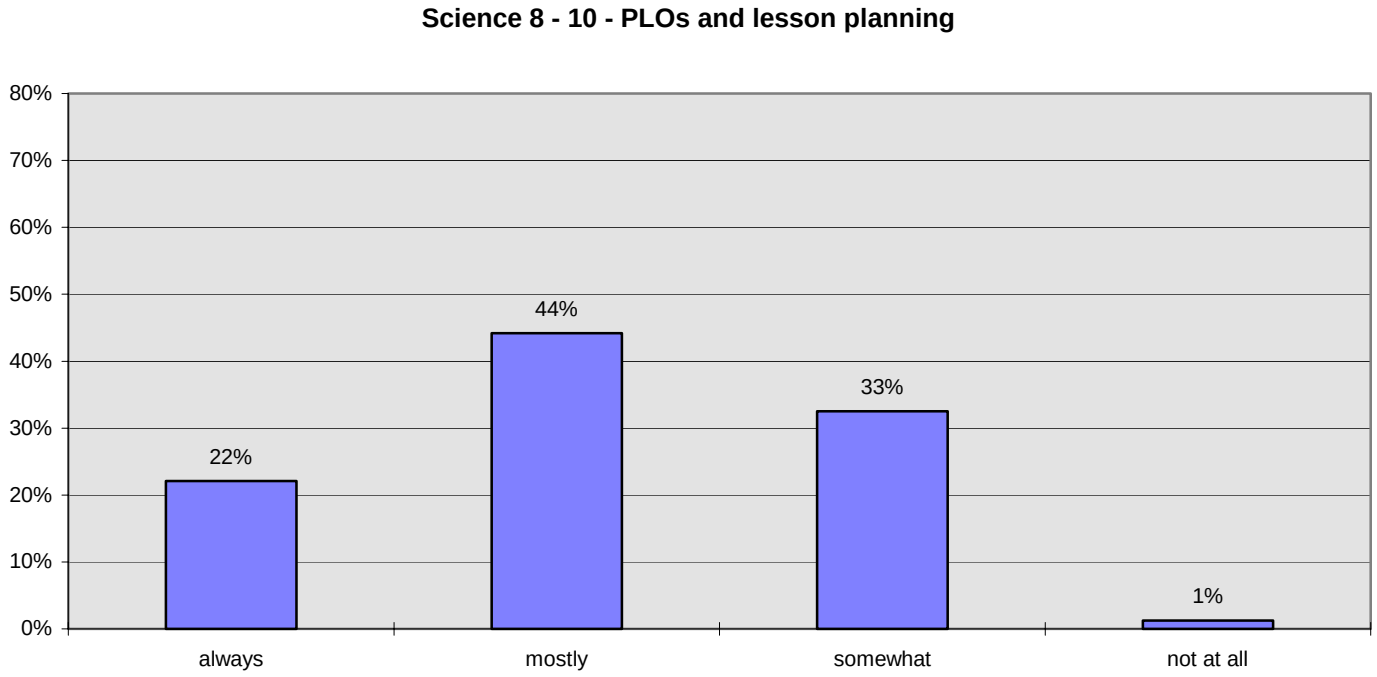
In the questionnaire, educators were asked to evaluate the Prescribed Learning Outcomes (PLOs) for their respective courses. Analysis of the Science 8-10 data indicates that less then half (43%) of educators think that the wording of the 8-10 PLOs is appropriate. The remainder of the respondents think that the PLOs are anywhere from vague to require more specificity (48%) to very inconsistent and require significant revision (only 2%).



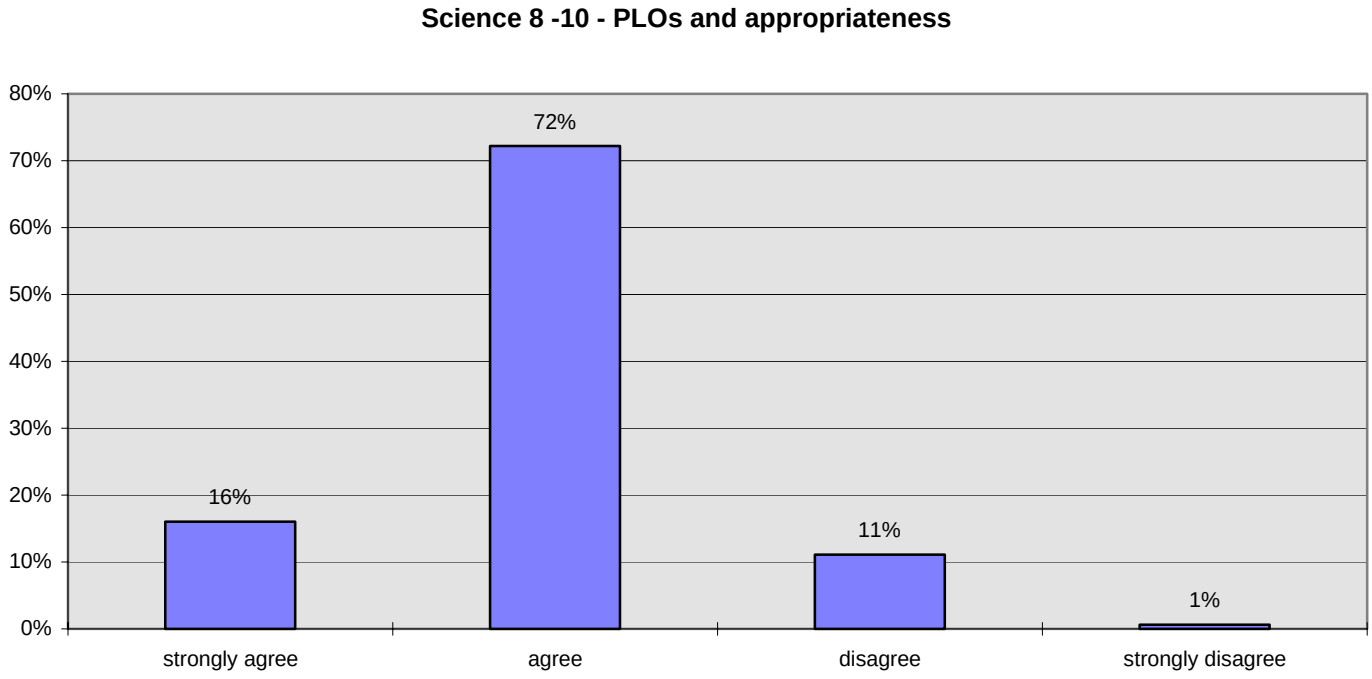
Fifty-four percent of respondents indicated that the number of PLOs in the IRP is appropriate to cover the content. While 31% of the respondents felt that the number of PLOs is excessive, 15% indicated that the PLOs were insufficient to cover the curriculum. It is possible that those who indicated the PLOs were insufficient might also have been in the 48% who felt they were vague and not well explained to describe what is to be taught in the courses.



Sixty-six percent of respondents indicated that they always/mostly use the IRP to guide their lesson planning .



Respondents were asked to indicate if they felt that the PLOs were grade appropriate. Findings show that most of the educators agree (72%) and strongly agree (16%).



The main concern raised in general comments about the PLOs is that there is too much to cover in each course which leads to superficial learning and a lack of time for hands-on Science. “Far too vague in general. Gives virtually no guidance regarding depth or breadth resulting in extremely different learning outcomes depending on the teacher’s choices, little consistency for students.” Another concern is the lack of specificity in the PLOs. For example, what should be covered in Science 8 regarding the 5 senses? It was expressed that this is especially important for beginning teachers.

Suggestions of topics of study that should be changed/added/deleted from Science 8 - 10 IRP

When asked if changes should be made to the topics of study in the Science 8-10 IRP, 46% responded "YES" and 54% "NO". Respondents were asked to give suggestions for changes.

The common suggested changes/additions/deletions for the Science 8 - 10 IRP

Science 8

- reduce the energy topic and eliminate Earth and Space Science as there is a lack of time
- reduce the ecology unit and delete biomes and ecosystems as they are taught in Science 7
- delete elements and periodic table as that is covered in Science 9 and 10
- add the drug unit that is now in Science 9
- add more chemistry in preparation for Science 9 and 10

Science 9

- delete geology as it is covered in elementary science and social studies

Science 10

- delete radioactivity as there is not enough time to cover it
- trim the electricity unit as there is a lack of equipment to teach it activity-based
- delete geology as it is rarely covered due to time constraints or move to Science 9
- more environmental Science
- increase attention given to sexual reproduction as it is not being covered in other courses

A general suggestion is to make the topics more relevant to the students lives.

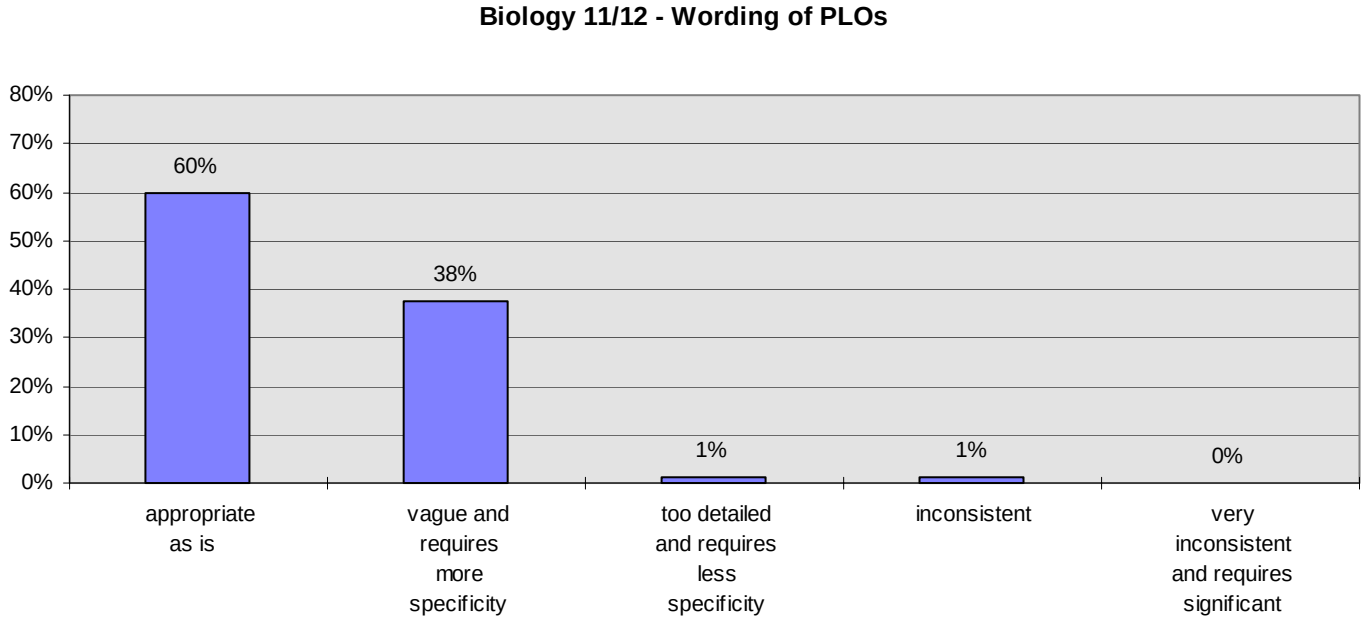
Principle Learning Resources for Science 8 - 10 IRP

The majority of teachers who responded to this question indicated that the *Science Probe Series* published by Nelson and *Explorer la Science* in the French Immersion classes are the principle learning resources. A few respondents mentioned that they used the *Prentice Hall Science Series.* When asked if they felt there were sufficient resources for the course only, 58% said "YES". A common comment was the fact that the textbooks do not always have a strong link to the PLOs. Another concern was the lack of current videos and the cost attached to resources and shrinking school budgets for resources. Educators who teach Science in French indicated that there is a lack of available resources.

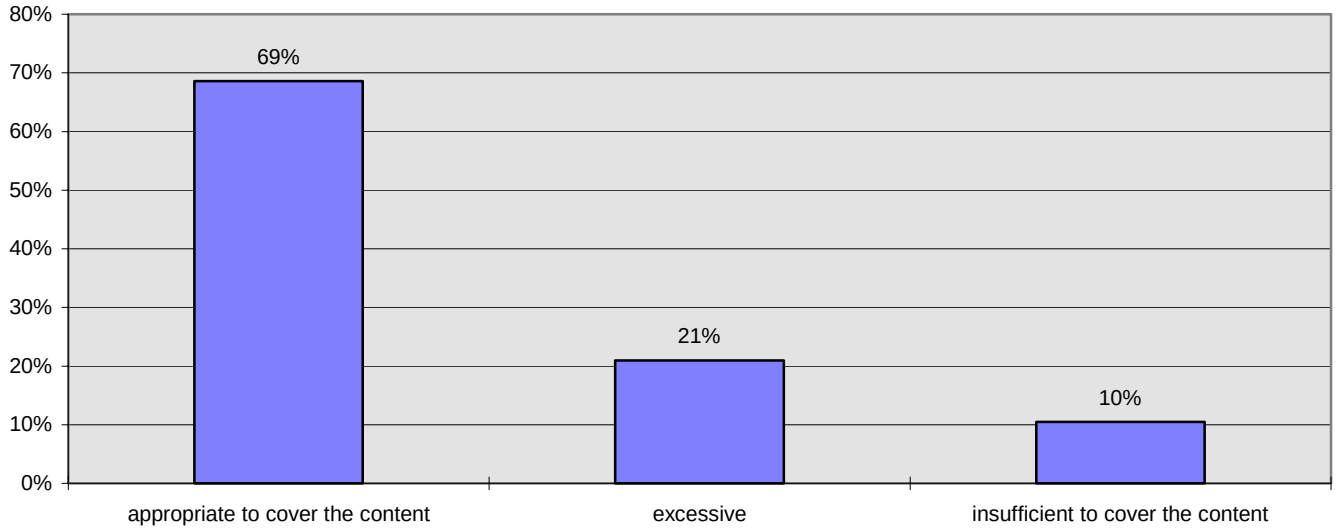
Biology 11/12 IRP

There were 89 respondents who evaluated the Biology 11/12 IRP. The following graphs illustrate the respondents' evaluation of the PLOs for the Biology 11 and 12 courses.

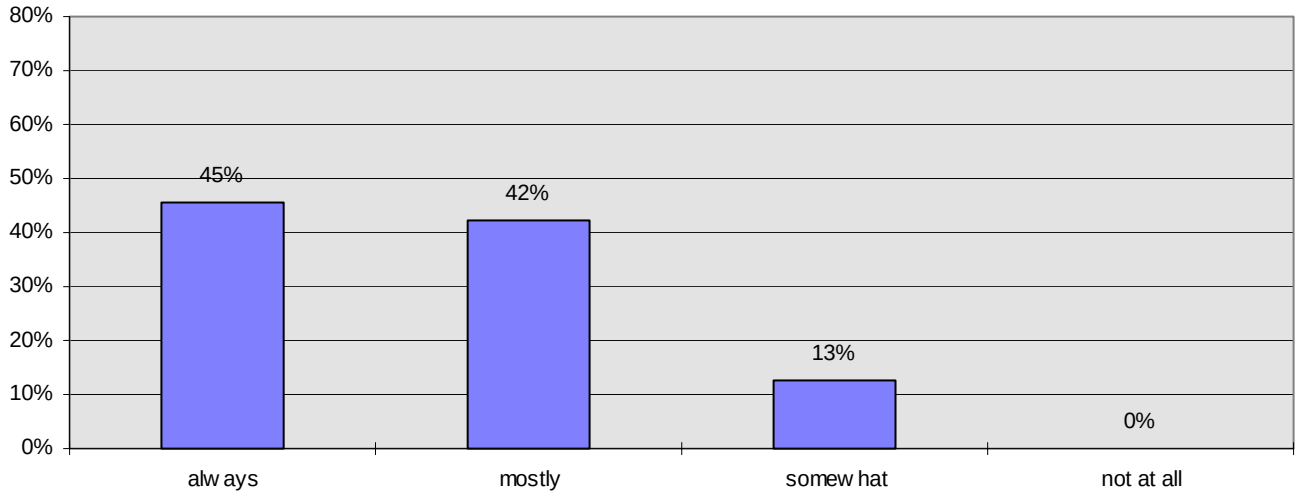
Although 60% of respondents felt that the wording of the PLOs is appropriate as is, 38% think that the PLOs are vague and require more specificity. A majority (69%) felt that the number of PLOs is appropriate to cover the content with only 21% indicating that there are too many PLOs. Respondents use the IRPs to guide the lesson planning (45% always and 42% mostly). The PLOs written for the Biology 11/12 IRP are considered grade appropriate by the majority of the respondents (98% strongly agree/agree).

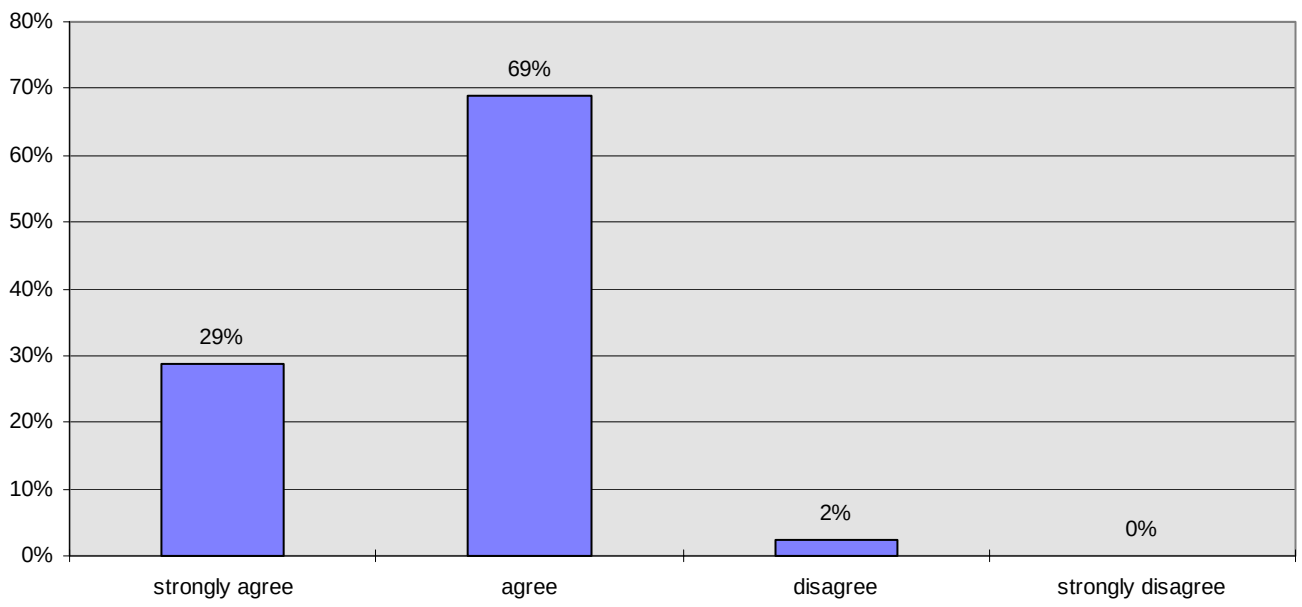


Biology 11/12 - Number of PLOs



Biology 11/12 - Use of PLOs for lesson planning





Numerous comments were made that some of the Biology 12 PLOs lack specificity as to the depth of coverage. Biology 11 respondents commented that it is difficult to cover all of the PLOs in depth as there are too many topics. There was also concern expressed about the lack of linkage between Biology 11 and 12.

In general, respondents appear to be satisfied with the Biology 11/12 IRP. Only 29% responded that they would like to see topics of study changed, added or deleted from Biology 11/12 IRP.

The common suggested changes for the Biology 12 course are as follows:

Add

- genetic engineering/biotechnology
- photosynthesis and cellular respiration
- immunology unit
- cell division to support the cancer unit
- muscular/skeletal system
- endocrine system

Delete

- reproductive system as it is covered in other courses
- cancer unit needs updated materials or moved to another course

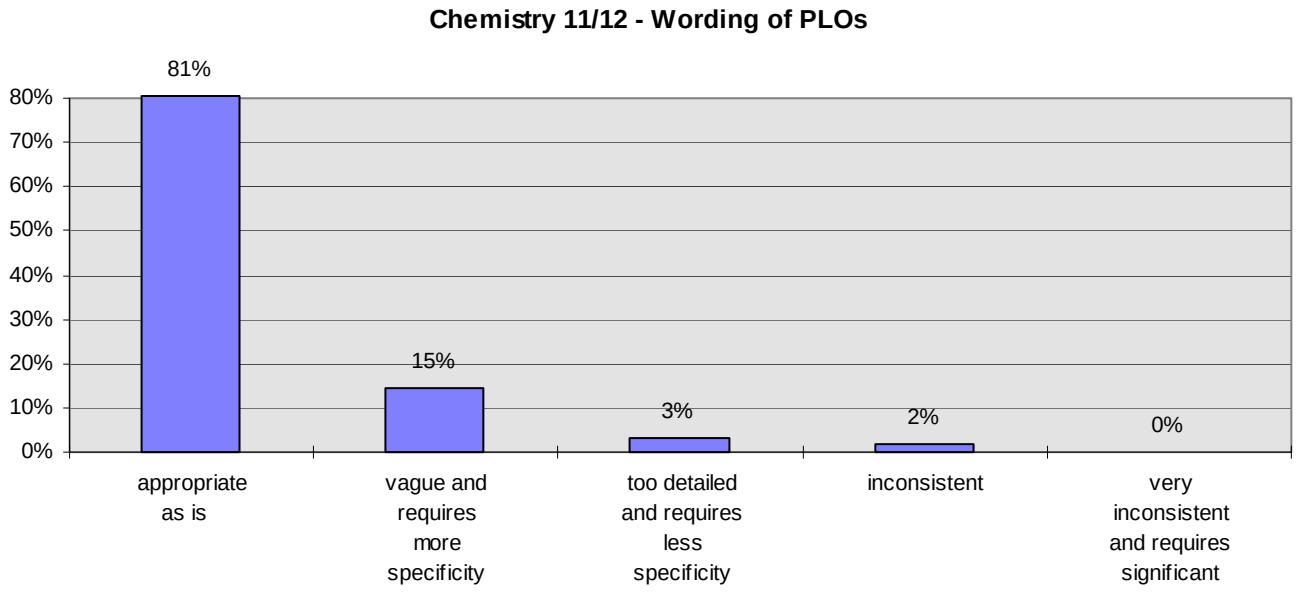
Insufficient comments were made by respondents evaluating the Biology 11 course to draw any conclusions about possible changes.

Principle Learning Resources for Biology 11/12

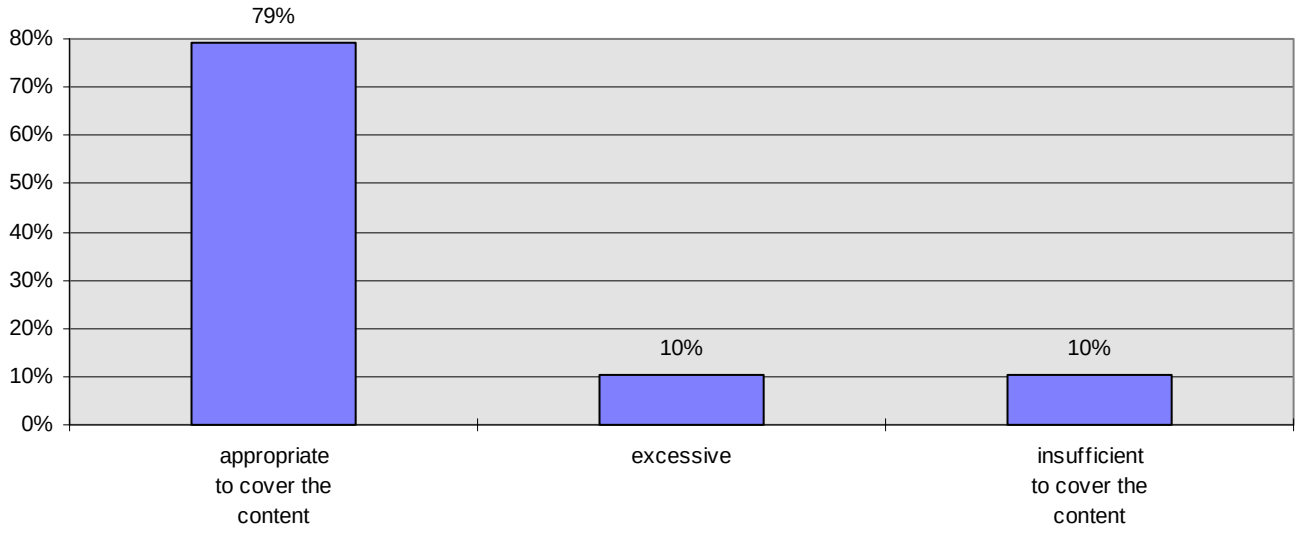
The most common textbook used by Biology 11 teachers is the Miller and Levine, *Biology* published by Prentice Hall Ginn. A few indicated that they use *Nelson Biology British Columbia Edition* published by ITP Nelson and the MacMillan *Biology* first used in the 1980s. The favoured Biology 12 textbook is *Inquiry Into Life* (5^{th} to 9^{th} edition) by Mader and published by McGraw-Hill Ryerson. A few indicated that they use *Nelson Biology British Columbia Edition* published by ITP Nelson.

Chemistry 11/12 IRP

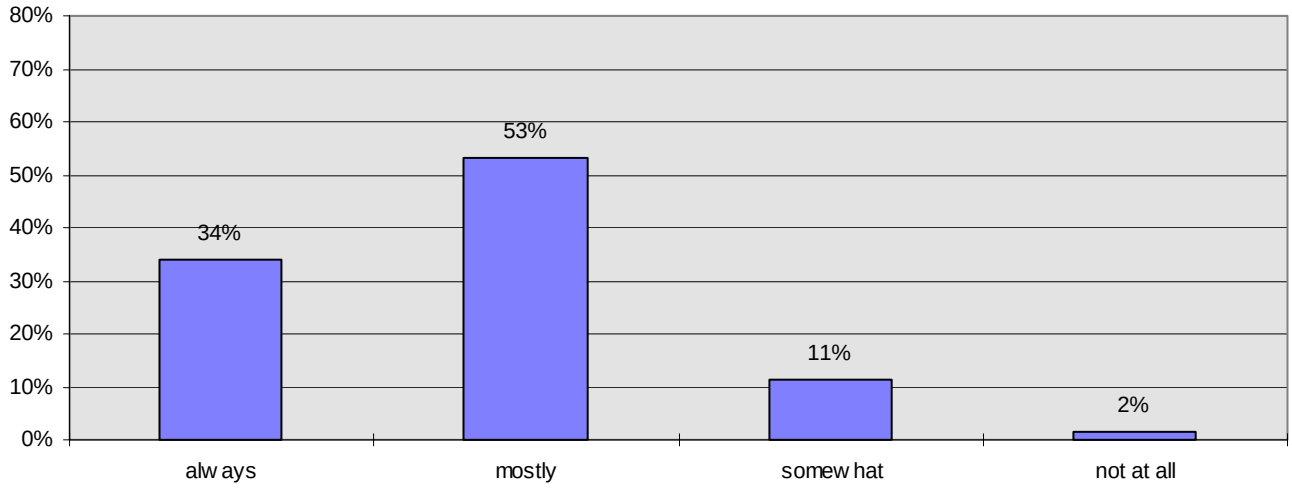
There were 64 respondents who evaluated the Chemistry 11/12 IRP. In the analysis of all of the Science 8-12 IRPs, the Chemistry teachers are the most satisfied with the IRP. 81% of respondents said that the wording of the PLOs is appropriate and 79% indicated that the number of PLOs is appropriate to cover the content. Like the Biology teachers, 87% always/mostly use the IRP to guide lesson planning. In regards to the grade appropriateness of the PLOs, 31% strongly agreed and 67% agreed.

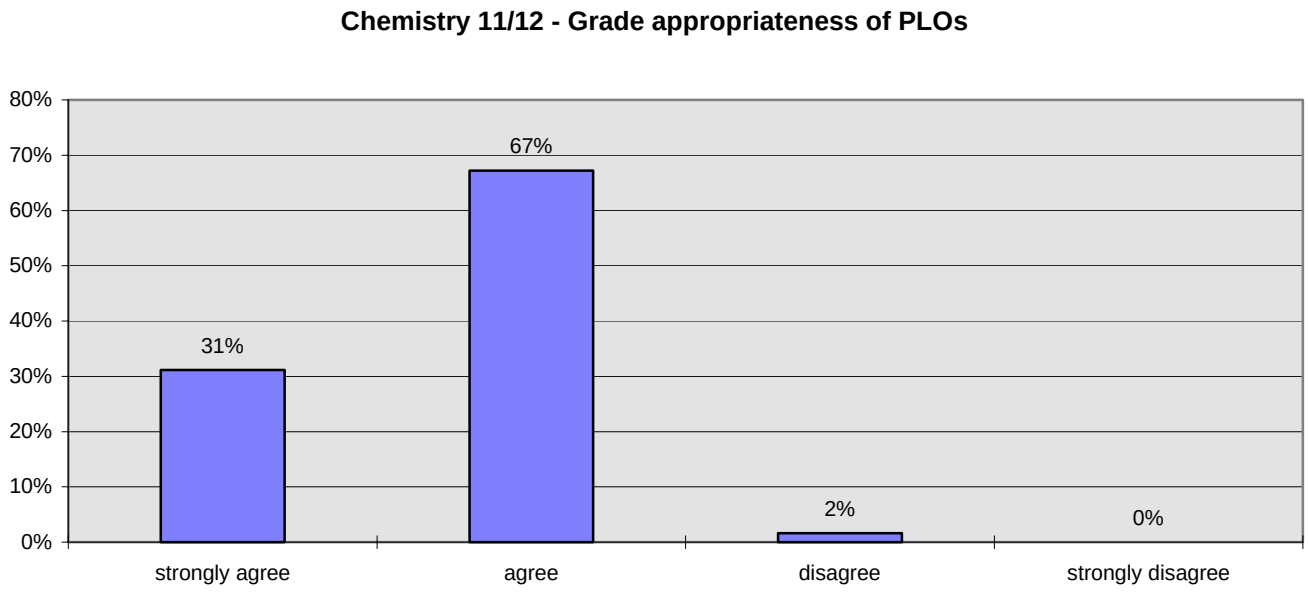


Chemistry 11/12 - Number of PLOs



Chemistry 11/12 - Use of PLOs for lesson planning





In general the respondents made positive comments about the Chemistry PLOs. Some commented that the combination of the Grade 12 PLOs and the government exam guide their teaching.

Topics of study changed, added or deleted from Chemistry 11/12 IRP

Of all of the respondents to this IRP, 53% indicated that some changes could be made to the Chemistry 11/12 IRP.

Chemistry 11

Add
- gas laws as it is needed at the post-secondary level
- solubility
- titrations

Chemistry 12

Add
- basic organic chemistry as it is interesting and real world chemistry
- thermodynamics as it is needed at the post-secondary level

Although there are a few suggested topics to add to enrich the two chemistry courses, there were few and often conflicting suggestions as to what should be removed.

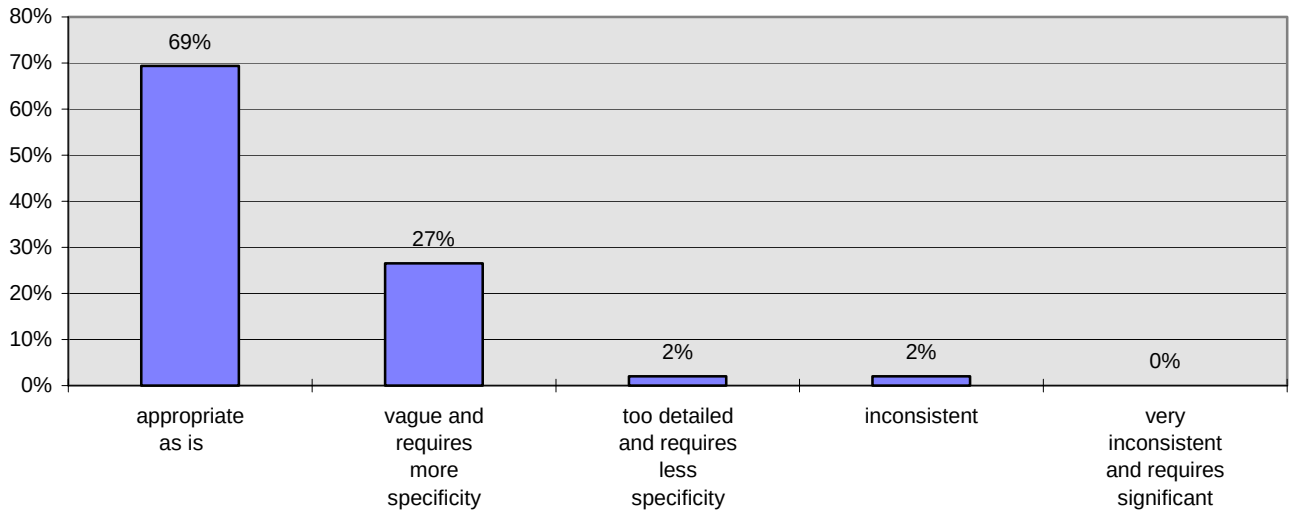
Principle Learning Resources for Chemistry 11/12

The majority of respondents cited resources used for the Chemistry 11/12 courses as *Hebden: Chemistry 11/12 - A workbook for Students* published by Hebden Home Publishing and *Heath Chemistry*. Some used *Nelson Chemistry, BC Ed*. Published by ITP Nelson Canada.

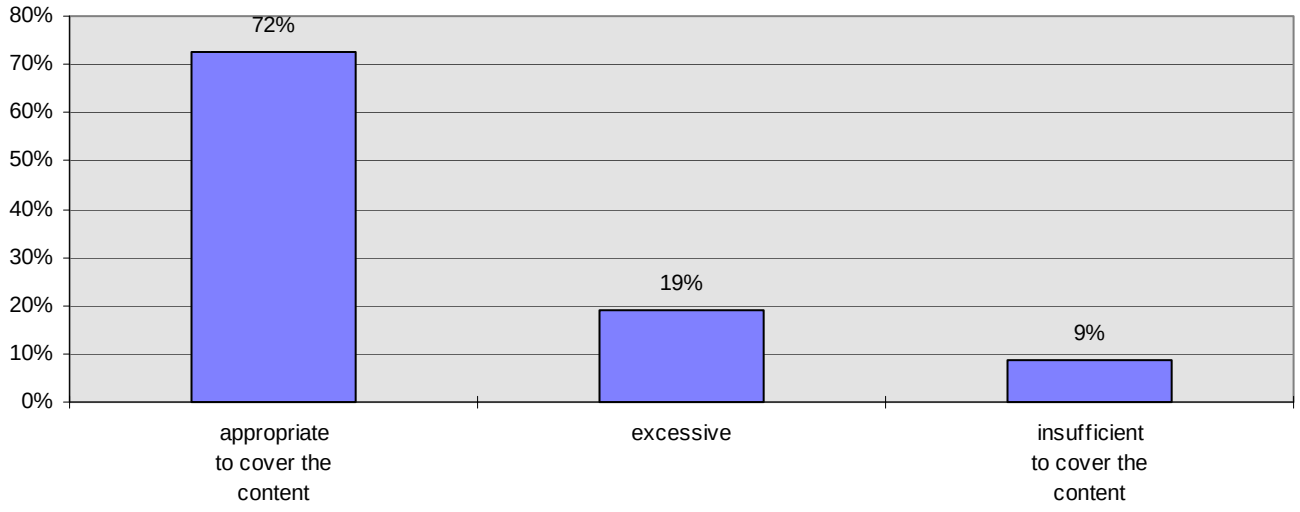
Physics 11/12 IRP

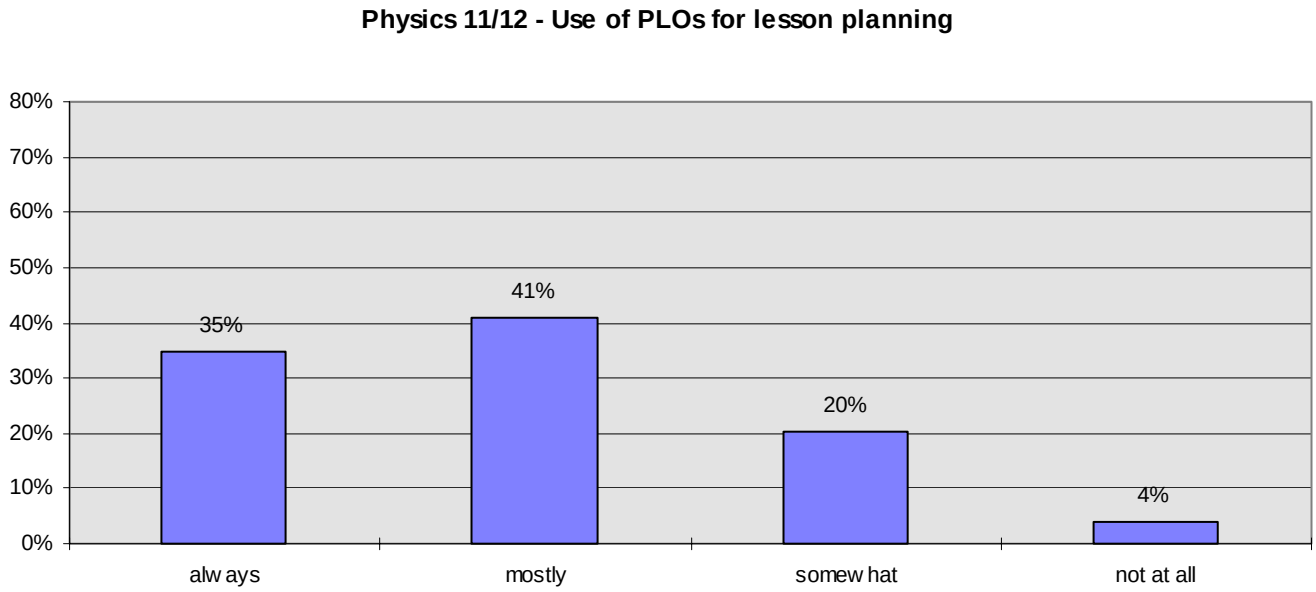
There were 52 teachers (13% of all 8-12 IRP respondents) who evaluated the Physics 11/12 IRP. It appears that Physics teachers are content with the Physics IRP, as indicated by the percentage of positive responses to the PLOs. Close to 70% of respondents indicated that the wording was appropriate and that there was the right number to cover the content. 76% of respondents use the PLOs to guide their lesson writing. There was strong agreement that the PLOs are grade appropriate as 95% strongly agree/agree.

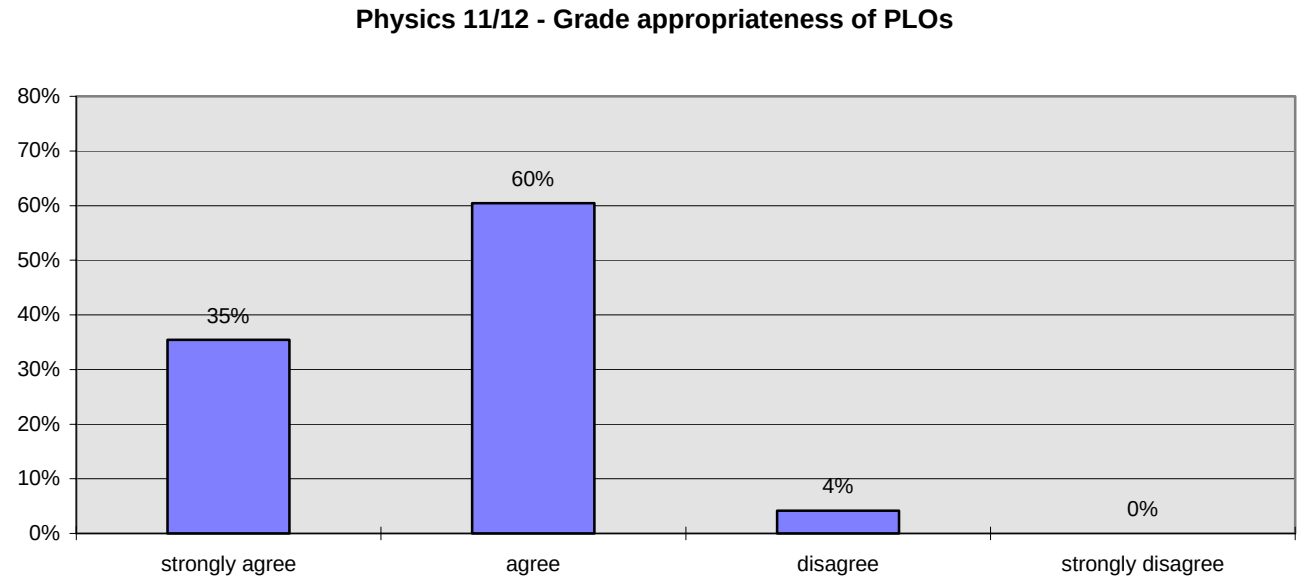
Physics 11/12 Wording of PLOs



Physics 11/12 Number of PLOs







A common concern about the PLOs raised by respondents is that there is little time to do lab work if all the PLOs are to be taught.

Suggested changes/additions/deletions for the Physics 11/12 IRP

As indicated by the previous graphs, respondents are relatively content with the Physics IRP. However 73% indicated that there were some topics of study that should be changed, added or deleted.

Physics 11

- delete optics or make it an option
- add electricity

Physics 12

- add some modern physics such as quantum physics

Principle Learning Resources for Physics 11/12 IRP

Those who responded to this question indicated that they used the following textbooks in the courses:

Physics 11 - *Fundamentals of Physics* published by ITP Nelson; *Glencoe Physics: Principles and Problems* published by McGraw-Hill Ryerson; *Merrill Physics: Principles and Problems, Canadian Edition* published by Prentice Hall

Physics 12 - *Physics: Principles with Applications* by Giancoli published by Prentice Hall Ginn; *Physics: Algebra/Trig*. by Hecht published by ITP Nelson;

Earth Science and Geology 12

There were insufficient responses to provide a significant analysis of this IRP. Fifty-seven respondents to the questionnaire said that they have taught Earth Science 11 over the past five years and 25 have taught Geology 12 but only 16 teachers (4%) evaluated the Earth Science 11 and Geology 12 IRP. This course has had an increasing enrollment over the last few years and it may be a course that will have a better response from teachers in a few years. In analyzing the few responses made about this IRP, it was found that the majority felt that the PLOs were grade appropriate but there were too many PLOs to adequately cover the course. The course would be better taught having fewer topics to cover.

Course	1995/1996	1999/2000	Total Increase	% of Increase
Earth Science 11	4596	6012	1416 students	31%
Geology 12	1360	1863	503 students	37%

(Information from Data Management and Student Certification Branch)

Principle Learning Resources for Earth Science and Geology 12 IRP

Heath Earth Science published by ITP Nelson; *Physical Geology* by Montgomery.

Science and Technology 11

The Science and Technology course has experienced a decrease in enrollment over the past few years. Data from the Data Management and Student Certification Branch indicates that in 1992/93, 5498 students completed the course but just 3515 students completed it in 1999/2000. This represents a decrease of 1983 students (36%) since 1992/93. Of all of the respondents, 54 teachers said that they have taught the Science and Technology 11 course in the past five years. Only 8 educators chose to evaluate this course via the questionnaire. This does not give enough data to provide significant analysis. However, the following points can be mentioned.

- resources are out of date and non-existant
- some of the topics are no longer relevant and needs to be updated
- need to modify the PLOs for a diverse group of students

Course	1992/1993	1999/2000	Total Decrease	% of Decrease
Science and Technology 11	5498	3515	1983 students	36%

Forests 11/12 IRP

Forests 11/12 is a relatively new IRP having been implemented in 1997. Data from the Data Management and Student Certification Branch indicates that the course is becoming more popular. There were only two responses to this course and both respondents felt PLOs are appropriate, cover the content, are mostly used in lesson planning, and agree they are grade appropriate.

Course	1997/98	1999/2000	Total33 Increase	% of Increase
Forests 11	420	786	366 students	87%
Forests 12	52	189	137 students	203%

Grade Collections

Teachers have requested that the Ministry identify a collection of resources for each grade level in order to provide guidance to schools for establishing relevant and comprehensive collections for the support of a curriculum or course. The Grade Collections are subsets of the previously Recommended resources from the Science IRPs as well as some newly identified resources that most closely match the prescribed learning outcomes. This Grade Collection was first published in 1998 with continual addition of resources.

Web Site for Grade Collections and Newly Recommended Resources
http://www.bced.gov.bc.ca/irp_resources/lr/resource/res_main.htm

As this is a relatively new document produced by the Ministry of Education. We wanted to learn how many of the respondents were familiar with the Grade Collections and whether they felt that there were sufficient resources to complement the 8-12 Science IRPs. 60% of the Grade 8-12 Respondents were familiar with the Grade Collections and 59% responded that they felt there were sufficient resources to complement the course.

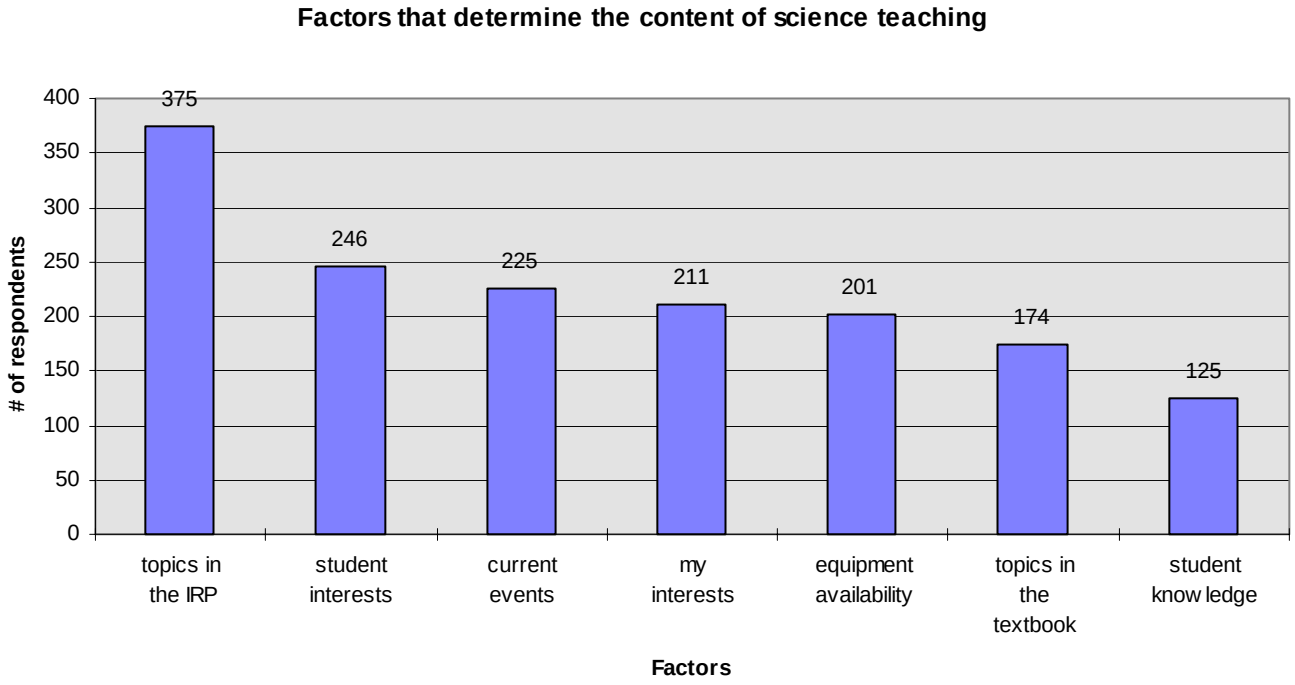
Frequent comments made in regard to having sufficient resources for the course.

- not enough money is available to purchase desired resources
- videos, especially, need to be updated, more plentiful and more relevant
- not enough resources available in French
- need to update the resource list quicker for current relevant materials
- resources are not available in School Districts
- need to improve the Canadian content
- need textbooks that link to current PLOs

Factors that determine the content of Science teaching in the 8-12 Science Courses

In the questionnaire, educators were asked to indicate, from a choice of seven different factors, what determined the content of their Science teaching. The most popular responses were the "topics in the IRP". "Student interests" and "current events" followed closely as favorite responses. It is to be expected that another popular response is teachers' interests. Although most teachers have access to a textbook for their respective courses, they do not let it dictate what they teach as less then half the respondents said that "topics in the textbook" determine the content of Science teaching. Other factors that were a common response from teachers were:

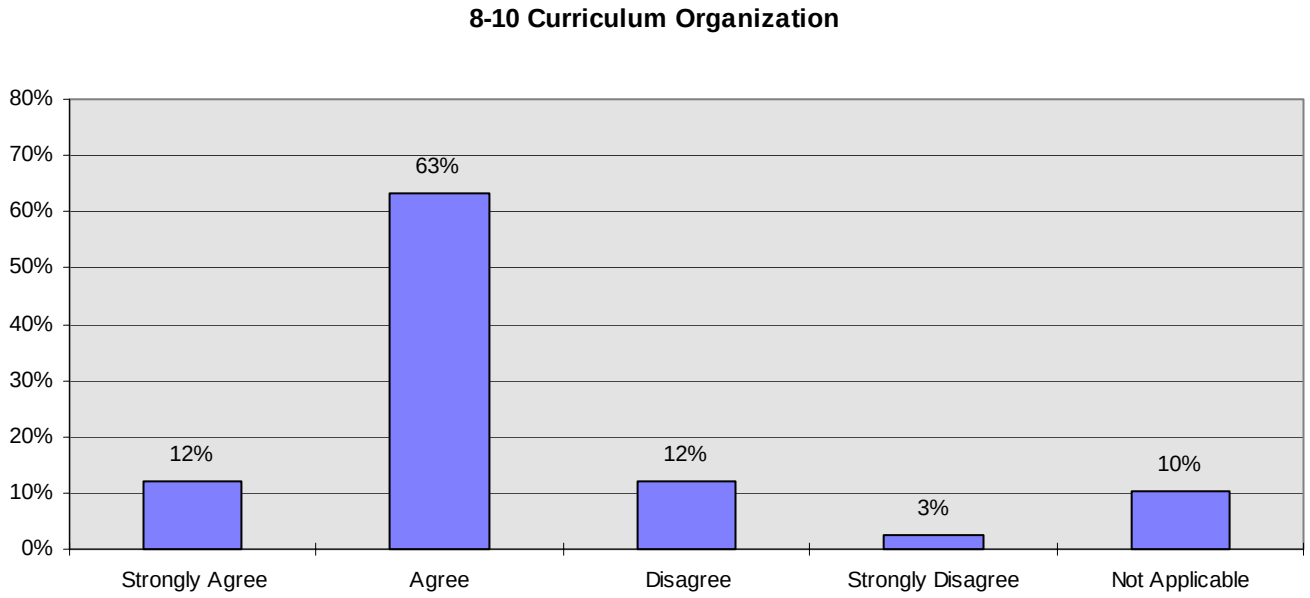
- Grade 12 Science courses are influenced by the final provincial exam
- Field trip opportunities and community resource people
- Time constraints



The General Curriculum Organization for Science 8, 9 and 10

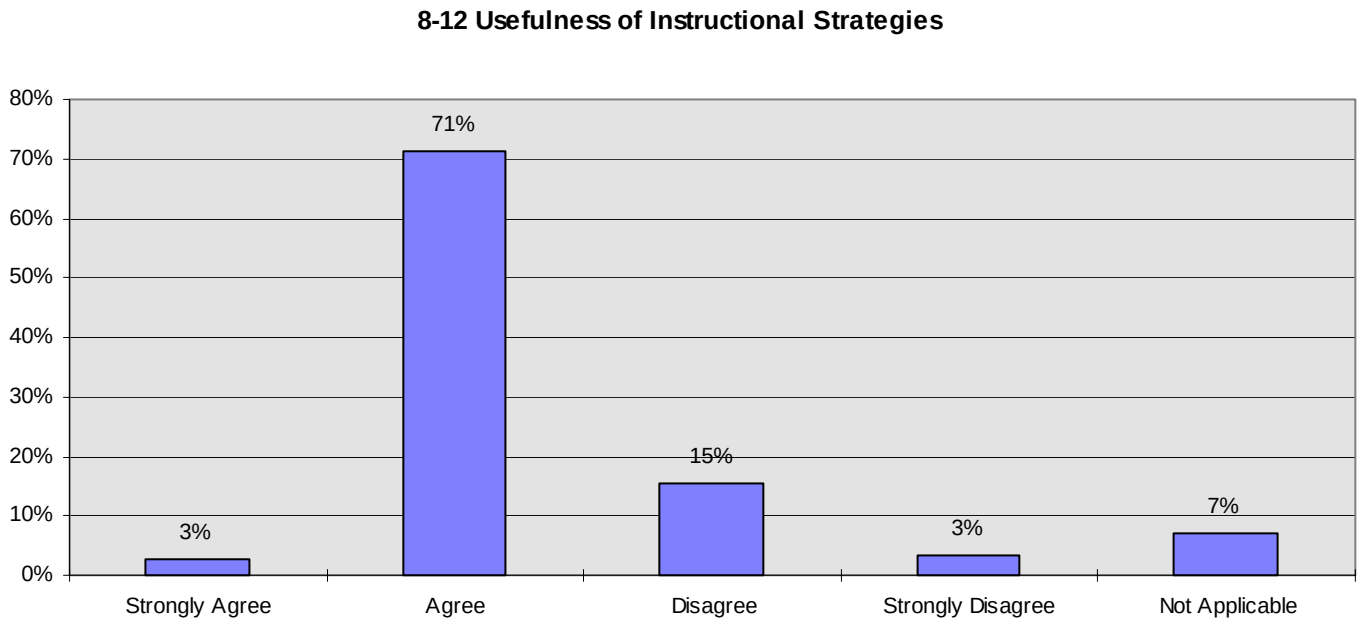
Respondents were asked to indicate if they agreed that the Science 8-10 IRP should be divided into the three content organizers of Life Science, Physical Science and Earth and Space Science. A large majority of the respondents agreed or strongly agreed (75%). Of those who disagree, the following suggestions were made:

- divisions should be biology/chemistry/physics/earth Science/Space Science
- sub-divide physical and life Science



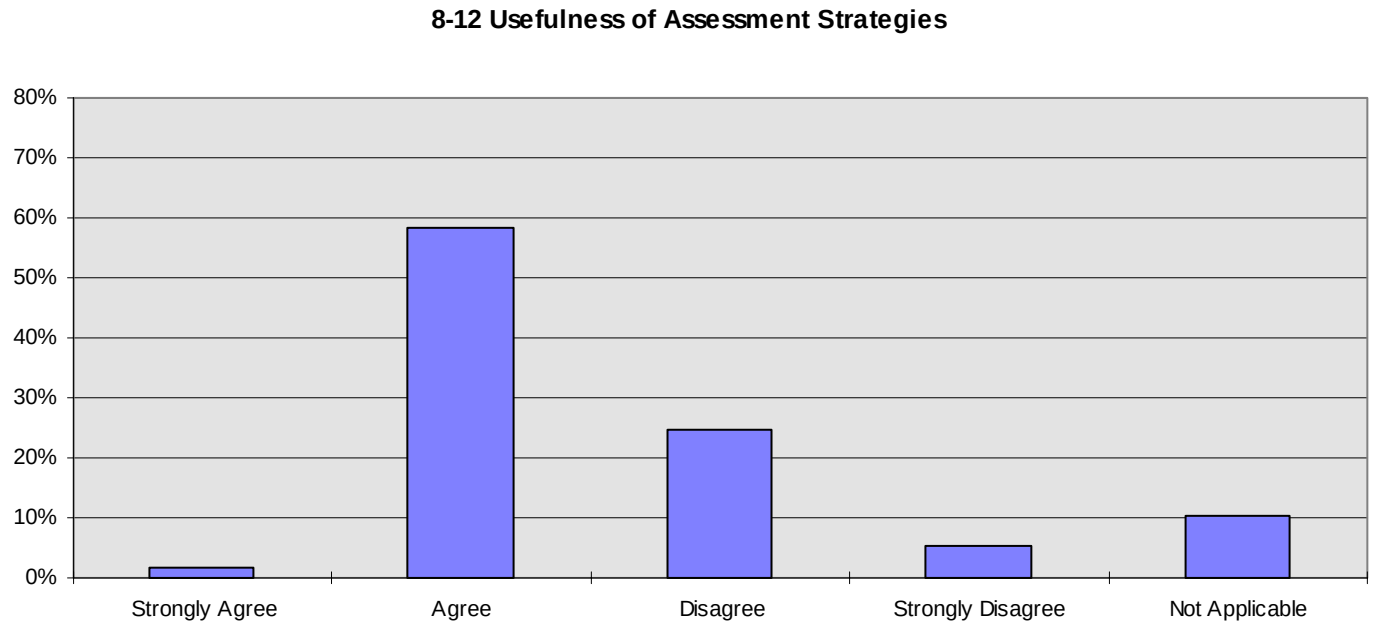
Usefulness of Instructional Strategies

A common comment made by respondents to the usefulness of the Instructional Strategies indicated that the strategies are useful to new teachers and that they contain a number of good ideas. However some were not applicable to schools outside the lower mainland or possible to do due to time constraints. It was suggested that there be continuous updating on a website as there is a need for more ideas. Also, the strategies help to clarify some of the PLOs. It could be considered that those respondents who did not agree with the usefulness of the instructional strategies do not refer to them in their teaching practice.



Usefulness of Assessment Strategies

60% of respondents agreed that the assessment strategies are useful, however, some respondents commented that they use their own assessment techniques or they have never yet read them. A common suggestion to improve the assessment strategies was the need for more practical examples that are easier to interpret. It was also suggested that the assessment strategies be directly linked to the instructional strategies.

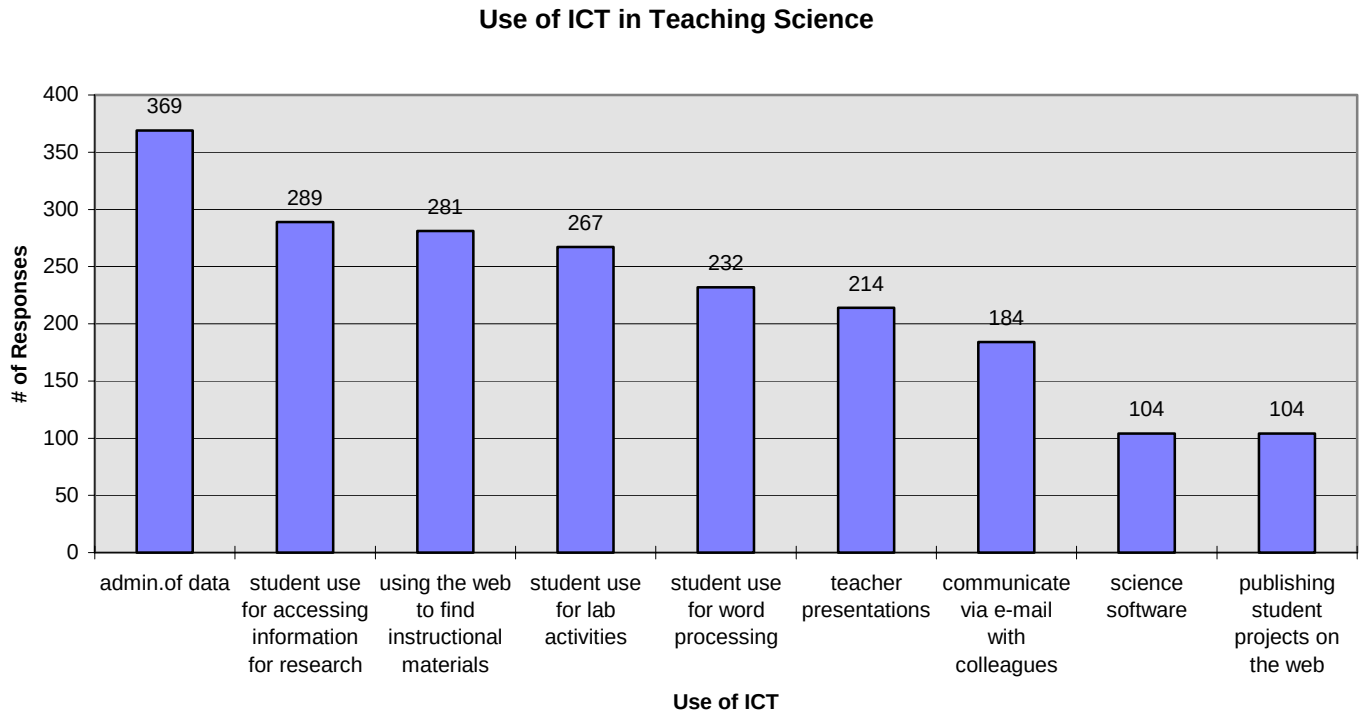


Use of ICT in teaching Science in the 8-12 Courses

Respondents were asked to indicate how they used information and communication technology in their teaching. As shown by the graph below, most of the respondents use ICT for the administration of data for handout preparation, marks gathering etc. A large number of respondents also use the web to find instructional materials. The other most common uses of ICT by students are accessing information using the internet and reference CDs; for lab activities such as dissections, probeware and graphing and also for word processing. Science educators use a wide variety of software.

The most commonly named Science software used by educators

- ADAM
- Body Works
- Science Workshop
- Starry Night
- Vernier Software
- Virtual dissections.



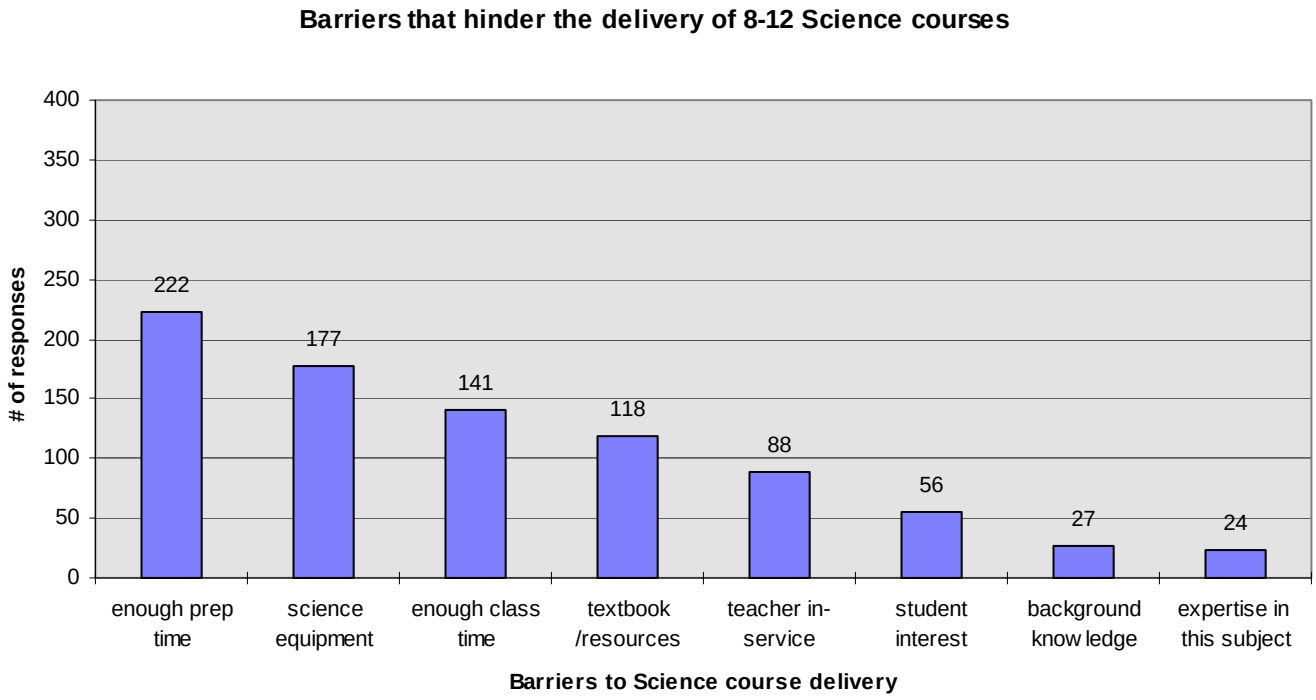
Aboriginal content in Science programs

The promotion of Aboriginal education is a priority with the Ministry of Education. Educators were asked if they integrated Aboriginal content into the Science programs. Only 14% responded that they did and in particular they discuss Aboriginal uses of plants and natural resources.

When asked what would be required to assist in the integration of aboriginal content, the most common responses were in-service and appropriate learning resources. The issues of time and course relevancy were also raised as some respondents did not feel that it is necessary to integrate aboriginal content into the curriculum

Barriers that hinder the delivery of Science courses

Respondents were asked to indicate which, if any, of the suggested eight possible barriers prevented them from delivering Science courses in their classroom. The four commonly reported barriers were; lack of enough preparation time; lack of Science equipment; lack of enough class time and lack of textbooks/resources. Other common barriers that were described by respondents were: lack of funding; lack of computers/technology; and lack of lab technicians.



Ministry of Education Science Safety Manual

The Science Safety Manual was first published in 1988 and reprinted in 1990 and distributed to all of the schools in the province. It was developed in response to safety needs as identified in the Provincial Science Assessments of 1978, 1982 and 1986, as well as concerns identified by various schools districts and the British Columbia Science Teachers' Association. Sixty-nine percent of the questionnaire respondents indicated that they were familiar with the manual. A few respondents commented that the manual is outdated and in need of revision.

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General Suggestions and Concerns expressed about Science in BC in the 8-12 Grades

There were many suggestions and concerns expressed by the respondents. Some have already been covered in the previous questions. The following are the most common comments reported:

Suggestions for the Classroom/ School

- reduce class size (24 or less) for lab safety
- improve Science equipment
- need more hands-on Science to engage the learner
- need for well equipped and readily available lab space
- improve Science education at the elementary level
- improve communication between teachers/feeder schools/other schools in the district/province/country and outside experts

Suggestions for the District

- fund District Science Coordinators and Lab Technicians
- put more funding into the purchase of Science equipment and supplies
- improve ProD funds for teachers to keep up with curriculum and advances in Science
- provide money to subsidize field trips
- promote Science fairs

Suggestions for the Ministry

- target funds for District Science Coordinators and Lab Technicians
- target funds for Science equipment and resources
- changes to the curriculum should come with complimentary resources and the money to buy them
- in-service of teachers is needed with curriculum revisions
- do not add to the PLOs as there are too many already and not enough time to cover them!
- make the curriculum current and relevant to students' lives
- make a website that is dynamic with links between PLOs and current recommended resources as well as lesson plans
- stop "watering down" the curriculum
- junior Science programs should be better preparing students for senior Science courses
- need better guidelines as to the level of depth of knowledge of each topic

SUMMARY and RECOMMENDATIONS

Report Summary

We are living in an era of rapid change - scientific, technical, economical, environmental, social and cultural. It is important that we are prepared to understand and benefit from these changes. Scientific literacy is a key component to coping with these changes. Just as changes are happening around us, revisions in Science education are necessary to promote scientific literacy among today's and tomorrow's youth. Current trends in Science education include the need to reduce the number of topics studied and approach Science with a more "depth' rather than "breadth" philosophy. It is recommended that the topics that are studied in a Science classroom be relevant to the lives of the students to encourage a curiosity for life-long learning. Furthermore, scientific topics introduced in-depth and built upon throughout Science courses may lead to increased understanding. Various educational agencies have identified key components to encourage the development of scientific literacy and have recommended specific content standards for Science curriculum development.

The Ministry of Education requires the regular review of provincial curriculum through its Curriculum Cycle. The K-12 Science curriculum has completed Phases 1 and 2 of the cycle. Data collection for the review has included formal and informal input from several sources such as; Overview Team consultation, discussion meetings with educators, literature searches, international and national Science assessment results and a Science Teacher Questionnaire for Curriculum Review distributed to every school in the province.

In reviewing B.C.'s results in national and international assessments of students' performance in Science, it can be concluded that B.C. is performing very well. The 1995 British Columbia Assessment of Mathematics and Science indicated that the overall performance of Grade 4, 7 and 10 students had declined since the 1991 assessment. Since that time, new Science curriculum has been implemented in schools and more current studies (TIMSS and SAIP) indicate an improved performance in Science assessments. General highlights of the studies indicate that there are very little gender differences in achievement and B.C. students hold positive attitudes towards Science.

Common concerns about Science education raised during the Science in B.C. Discussion Day and the 2000 & 2001 Science Overview Team Meeting were mirrored by educators in the Science Curriculum Review questionnaire. These concerns include

- the need to continually update the curriculum to ensure the importance of Science education in the B.C. school system
- the need for learning resources to complement the prescribed learning outcomes
- the need for teacher in-service to improve Science teaching

In many jurisdictions across Canada and the world, curriculum developers are revising Science curricula to promote scientific literacy in students. In 1997 the Council of Ministers of Education, Canada published the Pan-Canadian Science Framework (PCSF) with the goal to provide common ground for the development of Science curriculum across Canada. Most provinces and territories in Canada are currently undergoing Science curriculum revisions and many are connecting their Science programs to aspects of the PCSF. The Science Overview Team recommended that the B.C. Science curriculum revisions align to the PCSF through the integration of the four foundation statements in the PCSF.

Summary of the Science Curriculum Review Questionnaire.

There was a high rate of return of questionnaires (1661), particularly from the K-7 teachers (76% of returns). The average teaching experience of respondents is 14.9 years. This is lower then the general B.C. average teaching experience of 16.1 years.

The print version is the preferred version of the IRP. Respondents also indicated that they find the IRPs useful, particularly the four column format and Appendix A of PLOs. Educators rated the Introduction and Appendices B, C and D to be of limited use. Respondents gave good ratings to the organization of the IRP content, readability, ease of use, currency of information and the four column design.

K-12 Course Prescribed Learning Outcomes (PLOs)

Wording of PLOs

Responses indicate that teachers view the Science 8-10 and K-7 PLOs as too vague (48% and 24% respectively). The wording of the PLOs do not always provide clear direction.

Number of PLOs

In general the senior Science teachers (Grades 11 and 12) indicated that the number of PLOs is appropriate to cover the content. However, both the K-7 (43%) and 8-10 (31%) respondents felt that the number of PLOs is excessive. Similar results were found in the *1999 Evaluation of Uptake and Usefulness of Ten Selected IRPs* conducted by Angus Reed.

Use of PLOs for lesson planning

The majority of respondents reported using the PLOs for lesson planning.

Grade appropriateness of PLOs

Again the majority of respondents is satisfied with the grade level of the PLOs.

Topics of study changed/added/deleted

The respondents to the senior Science courses indicated quite strongly that there are topics of study that they would like to see changed/added/deleted. However, these are specific changes that would not require a complete revision of the courses. Thirty-two percent of K-7 respondents and 46% of 8-10 respondents felt that changes should be made to the IRP.

Principal learning resources and Grade Collections

K-7 teachers reported a lack of resources to assist them in the delivery of Science instruction. Many respondents commented on the amount of time that is spent looking for learning resources that are not comprehensive and often too expensive to purchase with school funds. Many elementary teachers reported spending their own money to purchase teaching resources. A large majority of the 8-10 Science teachers have access to textbooks but, they are viewed as outdated (especially for French resources) and do not address 100% of the PLOs. The senior Science courses are relatively well supplied with textbooks however there is a lack of learning resources for the Science and Technology 11 course. Teachers should be directed to the regional Grade Collection sites listed below so that they can preview resources. This may diminish the time that they spend searching for appropriate resources.

Regional Grade Collection Sites

#73 Kamloops (Provincial Host)
Henry Grube Education Centre
245 Kitchener Crescent
Kamloops B.C.
V2B 1B9
Corinne Parvantes
Phone - 250-376-2266
Fax - 250-376-7966
email - cparavan@sd73.B.C..ca

#8 Kootenay Lake (Regional Host
District Resource Centre
421-9th Ave
Creston B.C.
V0S 3P5
John Solly
Phone - 250-428-2051
Fax -250-428-5115
email - jsolly@pop.sd8.B.C..ca.

#34 Abbotsford (Regional Host)
Resource Centre
2272 Windsor St
Abbotsford B.C.
V2S 5W6
John Morrow
Phone - 604-852-1250
Fax - 604-854-5444
email - John_Morrow@SD34.B.C..ca.

#41 Burnaby (Regional Host)
Schou Education Centre
4041 Canada Way
Burnaby B.C.
V1Y 3A8
Ken Kiewitz
Phone - 604-664-8416
Fax - 604-664-8424
email - kkiewitz@csi.com.

#57 Prince George (Regional Host)
District Offices
1894 - 9th Ave
Prince George
V2M 1L7
Carrie Yuen-lo
Phone - 250-561-6800 ext258
Fax - 250-561-6801
email - carrie@central.scdist57.B.C..ca.

#61 Victoria (Regional Host)
S. J. Willis Centre
923 Topaz Ave.
Victoria B.C.
V8T 2M2
Judith Reid
Phone - 250 - 360 - 4302
Fax - 250 - 360 - 4371
email – jreid@sd61.B.C..ca.

#72 Campbell River (Regional Host)
Program Services
425 Pinecrest Road
Campbell River, B.C.
V9W 3P2
Byron Dart
Phone - 250-830-2300
Fax - 250-830-2329
email - Byron.Dart@sd72.B.C..ca

#82 Coast Mountains (Regional Host)
District Resource Centre
3211 Kenney Street
Terrace, B.C.
V8G 3E9
Warren Wilson
Phone - 250-635-4931
Fax – 250-638-2399
email – wwilson@cmsd.B.C..ca.

Factors that determine the content of Science teaching

It is interesting to note that although K-7 and 8-12 educators shared 'topics in the IRP' and 'students interests' as the most important factors that determine the content of Science teaching, 'equipment availability' was the third most important factor for K-7 teachers and 'current events' for 8-12 teachers. Science 8-12 teachers also rely more often on topics in the textbook to influence the content of Science teaching. In general, Grade K-6 teachers do not have comprehensive textbooks available to use in their classrooms. Grade 7 teachers reported using *Science Probe 7*.

Activity-based K-7 Science Program

Responses to the questionnaire indicate that K-7 teachers are integrating more activity-based learning into their Science courses. This is a promising observation as the 1995 PLAP study indicated that "activity-based Science must be on the timetable of every student from Kindergarten to Grade 10". However the obstacles to doing even more activity-based Science programs are; the lack of equipment, lack of learning resources, the topics of study; and, the preparation time available to the teacher.

Grade 8-10 Curriculum Organizers

Respondents to the questionnaire appear to be satisfied with the current 8-10 curriculum organizers of Life Science, Physical Science and Earth and Space Science.

Usefulness of Instructional Strategies

Approximately three quarters of respondents find the instructional strategies useful in their teaching practise. The instructional strategies clarify the PLOs and are a starting point for new ideas and are of particular use to new teachers. However, there were criticisms of the instructional strategies in that some are not practical due to student ability and classroom capabilities.

Usefulness of Assessment Strategies

Responses to this question indicate that K-7 educators find the assessment strategies more useful then the 8-12 teachers. Comments indicate that experienced teachers tend to use their own assessment strategies. However, the assessment strategies are a starting point and useful to new teachers.

Teaching Science in split/combination classes

It is a difficult to suggest that teachers are able to cover all of the PLOs for each level in a split grade classroom. It is encouraging to note that many schools have created an A/B program so that the PLOs are covered over a two year period. This requires time for communication between teachers but is a solution to a concern in the elementary system when dealing with combination classes. Many respondents commented that there is a need for IRPs that address split classes and/or instructions on how to teach Science in split classes. It is a concern that all of the PLOs for Science are not being addressed for all students when Science is taught in a multi-grade classroom. It was commonly suggested that the K/1 and the 2/3 PLOs should be separated into each grade as this is not always the split that happens in schools and it is difficult to figure out which IRPs should be covered at each level. These thoughts were echoed in results of the October 20, 2000 Science in B.C. Discussion Day and the 1998 IRP Study.

Use of information and communication technology in teaching Science

Educators indicated that they use information and communication technology for the administration of data such as handout preparation and marks gathering. They also use the web to find instructional materials. Grade K-7 and Grade 8-12 students use ICT for word processing and accessing information for research purposes. Grade 8-12 students use ICT for lab activities more often then Grade K-7 students.

Aboriginal content in Science programs

Aboriginal education is a current priority with the Ministry of Education. Responses indicate that aboriginal content is not commonly integrated into Science programs. When it is, it is only mentioned in passing such as how First Nations people used natural resources. Most respondents seemed responsive to integrating aboriginal education but indicated that there is a need for appropriate in-service and learning resources and more time in the teaching day.

Barriers that hinder the delivery of Science courses

Although respondents indicated the same top four barriers that hinder the delivery of Science courses, they were given different priority as shown in the table below. Time is also a factor for all Science educators specifically for lesson/activity planning and for teaching all of the PLOs. These factors may hinder the ability for educators to provide an activity-based Science program.

K-7	8-12
1. Lack of textbook/resources	1. Lack of enough preparation time
2. Lack of Science equipment	2. Lack of Science equipment
3. Lack of enough preparation time	3. Lack of enough class time
4. Lack of enough class time	4. Lack of textbook/resources

Ministry of Education Science Safety Manual

This document is better recognized in the 8-12 schools (69%) than in the K-7 schools where only 21% of respondents indicated that they were familiar with the Science Safety Manual. The lack of familiarity with this document raises concerns about the issue of safety in the Science classroom.

Recommendations

1. That the following Science IRPs be revised in the order listed below.

Science K-7

Results indicate that 32% of the K-7 teachers who responded to the questionnaire would like to change topics of study in the IRP. They also indicated that the number of PLOs are excessive (43%). Current research indicates that there should be a reduction in the number of topics in the Science curriculum and the removal of excessive detail from the topics that remain (Linn & Hsi, 2000; Marlow, 1999; AAAS, 2001). It is recommended that the number of PLOs be reduced and/or a reduction in topics of study. A similar recommendation was made out of the Review of Learning Outcomes Report, 1999. This report also recommended that there be a reduction in the amount of overlap of PLOs across subject areas. It is also recommended by the Science Overview Team that there is an alignment with the Pan-Canadian Science Framework. Revisions should be made with a view to ensuring that high quality learning resources are available to support the curriculum at the time of its implementation. This will help meet the needs of the 41% of respondents who felt that there are insufficient learning resources to complement the IRP.

Science 8-10

Results indicate that educators are not satisfied with the wording of the prescribed learning outcomes (PLOs) finding them to be vague and requiring more specificity. It should be noted that only 54% of respondents believe that the PLOs are appropriate to cover the content. Although the PLOs are grade appropriate, there appears to be a need to revise the wording of the PLOs and to reduce the quantity of topics for greater depth of understanding. It is also recommended by the Science Overview Team that the Science 8-10 topics of study by aligned to the Pan-Canadian Science Framework and what is happening elsewhere in Canada in order to have improved access to quality comprehensive textbooks and resources and improved continuity in the K-12 Science program.

Science and Technology 11

It is recommended that a thorough review be conducted to assess the viablity of Science and Technology 11 in the B.C. school system. The supporting learning resources are outdated and unavailable and enrollment in this course has decreased since 1992. If it is determined that this course is an asset to the K-12 Science program, then it is recommended that the curriculum be revised, updated and linked with appropriate learning resources. The Science Overview team recommended that the course have options so that schools can offer it with a regional emphasis. This should be a practical general Science 11 course.

Senior Science Courses - Biology, Chemistry, Physics

These courses had the lowest rate of return of responses. This may indicate that teachers are relatively content with the PLOs for the courses. Results indicate that there are some suggested topics of study that could be changed. Over 60% of respondents indicated that there are sufficient resources to complement the course.

Agriculture 11, Applications of Physics 11 and 12, Earth Science 11 and Geology 12, Forests 11 and 12

It is recommended that a detailed review of these courses be conducted at a later date.

Recommended timeline for implementation of revised IRPs

IRP	Writing of Draft	Drafts to the field for Input	Editing of Draft	Available for Implementation	Year IRP commences implementation
Science K-7	Spring 2001	September 2001-December 2001	January 2002-April 2002	September 2002	September 2003
Science 8-10	April 2002-June 2002	September 2002-December 2002	January 2003-April 2003	September 2003	September 2004
Science and Technology 11	April 2003-June 2003	September 2003-December 2003	January 2004-April 2004	September 2004	September 2005
Biology 11/12 Physics 11/12	April 2004-June 2004	September 2002-December 2002	January 2005-April 2005	September 2005	September 2006
Chemistry 11/12 Another Science	April 2005-June 2005	September 2004-December 2004	January 2006-April 2006	September 2006	September 2007

2. **That there be increased integration of information and communication technology and aboriginal content.**

3. **That the Science Safety Resource Manual be revised.**

4. **That the existence of Grade Collections documents continue to be communicated to teachers to promote their use.**

   Respondents stated that they spend a lot of time looking for resources. Only 57% of respondents are familiar with the Grade Collections documents published in 1998. Therefore it is important for the Ministry to continue to promote the existence and updating of the Grade Collections. It is also recommended that publishers be aware of the Grade Collections and the continuous submission process.

5. **That curriculum branch staff communicate with School Districts and Field Services to encourage the development of a plan for IRP implementation.**

The most important recommendation is…

“that we set students on a path towards lifelong Science learning”

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www.qca.org.uk/ca/5-14/revised2000/subjects.asp
www.nc.uk.net/about/targets-levels.html
www.unesco.org/education/educprog/ste/projects/child-views/exposition.htm

Appendix A

BRITISH COLUMBIA

K to 7 Science Teacher Questionnaire for Curriculum Review

Dear Educator

Thank you for participating in this questionnaire. It is part of the review process that we are using at the Ministry of Education to determine where we should be focusing our attention to improve the K to 7 Integrated Resource Package that was published in 1995. We appreciate your input (which will remain anonymous). This questionnaire can also be downloaded from the Ministry Web Site at at http://www.bced.gov.bc.ca/branches/pser/whatsnew.htm. **Please encourage your colleagues to participate!**

1. What is your current teaching assignment? (Grade(s) and Subject(s))

   _____

2. How many years have you been teaching? _____

3. In which school district do you work? Please give name and number. _____

4. Do you teach in a ❒ Public school or an ❒ Independent school or a ❒ First Nations school? **Please check**.

5. Please indicate the size of your school:
   ❒ small (less than 100 students) ❒ medium (101 to 500 students) ❒ large (over 500 students)

GENERAL IRP QUESTIONS

6. Which of the following IRP version have you used? Please check all that apply.
   ❒ in print ❒ on CD-Rom ❒ on the Web (html)

7. Which of the IRP versions do you prefer to use for your planning? (**Please check only one**.)
   ❒ print ❒ CD-ROM ❒ Web

8. Please rate the usefulness of the following components of the IRPs:

Introduction including philosophy, rationale, content overview	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Main body of the IRP containing the 4 column format	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix A: Prescribed Learning Outcomes	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix B: Learning Resources and Grade Collection Information	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix C: Cross-Curricular Interests	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix D: Assessment and Evaluation	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Other _____	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful

9. Please rate the following elements of the IRPs.

a) organization of the content	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
b) readability	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
c) ease of use	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
d) currency of information	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
e) design including 4 column format	❒ excellent	❒very good	❒ good	❒ fair	❒ poor

Comments: _____

SCIENCE RELATED IRP QUESTIONS

1. Since 1995, what grades have you taught?_____

2. Please choose a Grade that you have taught *within the past two years* and answer the following questions.
   (Please complete a separate questionnaire for each Grade that you would like to have input into for the review process.)

   Please indicate the Grade that you are responding to _____

3. Please give an estimate of the % of time that you spend teaching Science during the course of the year. _____%

4. **Prescribed learning outcomes** (PLOs)are content standards for the BC education system. They set out the knowledge, enduring ideas, issues, concepts skills, and attitudes for each subject. The PLOs are statements of what students are expected to know and do at an indicated grade.

In general, the wording of current PLOs is	❒ appropriate as is ❒ vague and requires more specificity ❒ too detailed and requires less specificity ❒ inconsistent ❒ very inconsistent and requires significant revision
The number of PLOs in the IRP is	❒ appropriate to cover the content ❒ excessive ❒ insufficient to cover the content
To what extent do the PLOs of this IRP guide your lesson planning?	❒ always ❒ mostly ❒ somewhat ❒ not at all
The PLOs are grade appropriate	❒ strongly agree ❒ agree ❒ disagree ❒ strongly disagree

Comments about PLOs _____

_____

_____

_____

5. Are there topics of study that you would like to see changed, added or deleted from this Grade? ❒ Yes ❒ No

   Please identify each topic and explain why the change should be made: _____

   _____

   _____

   _____

6. Please name the **principal learning resource(s)** that you use for this course.

   _____

   _____

7. a) Are you familiar with the Grade Collections of recommended resources for this course? ❒ Yes ❒ No

   b) Do you feel that there are sufficient resources to complement this course? ❒ Yes ❒ No

   Comments_____

8. What are the factors that determine the content of your Science teaching? (***Please mark all that apply***.)

   ❒ topics in the IRP ❒ student interests ❒ topics in the textbook

   ❒ student knowledge ❒ equipment availability ❒ current events

   ❒ my interests ❒ other _____

9. I would consider my Science program to be activity-based.

   ❒ Strongly Agree ❒ Agree ❒ Disagree ❒ Strongly Disagree ❒ Not Applicable

   Comments_____

10. The suggested ***Instructional Strategies*** are useful.

    ❒ Strongly Agree ❒ Agree ❒ Disagree ❒ Strongly Disagree ❒ Not Applicable

    Comments_____

11. The suggested ***Assessment Strategies*** are useful.

    ❒ Strongly Agree ❒ Agree ❒ Disagree ❒ Strongly Disagree ❒ Not Applicable

    Comments_____

12. If you teach/have taught a split/combination class, do you implement the PLOs for each grade? ❒ Yes ❒ No ❒ n/a

    Comments_____

13. Identify the information and communication technology that you use in your teaching. *Please check all applicable responses*.

    ❒ administration of data (handout preparation, marks gathering etc.)

    ❒ communication via e-mail with Science colleagues (inside and outside school)

    ❒ using the web to find instructional materials

    ❒ teacher presentations (power point, demonstrations)

    ❒ student use for lab activities (dissections, probeware, graphing, simulations)

    ❒ student use for accessing information for research projects (internet, Web resources, reference CDs)

    ❒ publishing of student projects on the Web

    ❒ student use for word processing

    ❒ Science software. Give examples _____

    ❒ Other _____

14. Please any barriers which hinder you or your school from delivering this Science course.

❒ lack of background knowledge ❒ lack of enough class time ❒ lack of Science equipment

❒ lack of textbook/resources ❒ lack of teacher in-service ❒ lack of enough prep time

❒ lack of student interest ❒ lack of expertise in this subject ❒ Other _____

15. Are you familiar with the Ministry of Education Science Safety Manual? ❒ Yes ❒ No

16. Do you integrate Aboriginal content into your Science program? ❒ Yes ❒ No

If yes, please indicate what you do. _____

_____

If no, what would assist you to integrate Aboriginal content in your Science program?_____

_____

17. What suggestions/concerns do you have about Science in BC? Please consider this from the perspective of the Classroom, School, District and Ministry of Education?

_____

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☺ Thank you for completing this questionnaire.

PLEASE RETURN BY *FRIDAY DECEMBER 15, 2000*

Please return it to Darlene Monkman, Science Curriculum Coordinator, British Columbia Ministry of Education

BY FAX: (250) 387-1527 OR BY MAIL: PO Box 9152 Stn Prov Govt Victoria, BC V8W 9H1

QUESTIONS OR COMMENTS? **E-MAIL:** Darlene.Monkman@gems1.gov.bc.ca
PHONE: (250) 387-4410

Appendix B

BRITISH COLUMBIA

8 to 12 Science Teacher Questionnaire for Curriculum Review

Dear Educator

Thank you for participating in this questionnaire. It is part of the review process that we are using at the Ministry of Education to determine where we should be focusing our attention to improve the K to 12 Science IRPs (Integrated Resource Packages). We appreciate your input (which will remain anonymous). This questionnaire can also be downloaded from the Ministry Web Site at http://www.bced.gov.bc.ca/branches/pser/whatsnew.htm. **Please encourage your colleagues to participate!**

1. What is your current teaching assignment? (Grade(s) and Subject(s))

   _____

2. How many years have you been teaching? _____

3. In which school district do you work? Please give name and number. _____

4. Do you teach in a ❒ Public school or an ❒ Independent school or a ❒ First Nations school? **Please check**.

5. Please indicate the size of your school:
   ❒ small (less than 100 students) ❒ medium (101 to 500 students) ❒ large (over 500 students)

GENERAL IRP QUESTIONS

6. Which of the following IRP version have you used? Please check all that apply.
   ❒ in print ❒ on CD-Rom ❒ on the Web (html)

7. Which of the IRP versions do you prefer to use for your planning? (**Please check only one**.)
   ❒ print ❒ CD-ROM ❒ Web

8. Please rate the usefulness of the following components of the IRPs:

Introduction including philosophy, rationale, content overview	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Main body of the IRP containing the 4 column format	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix A: Prescribed Learning Outcomes	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix B: Learning Resources and Grade Collection Information	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix C: Cross-Curricular Interests	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Appendix D: Assessment and Evaluation	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful
Other _____	❒ very useful ❒ somewhat useful	❒ useful ❒ not useful

9. Please rate the following elements of the IRPs.

a) organization of the content	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
b) readability	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
c) ease of use	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
d) currency of information	❒ excellent	❒very good	❒ good	❒ fair	❒ poor
e) design including 4 column format	❒ excellent	❒very good	❒ good	❒ fair	❒ poor

Comments: _____

SCIENCE RELATED IRP QUESTIONS

1. Please all courses that you have taught since 1995.

❒ Science 8	❒ Science 9	❒ Science 10
❒ Biology 11	❒ Chemistry 11	❒ Earth Science 11
❒ Forests 11	❒ Physics 11	❒ Agriculture 11
❒ Applied Physics 11	❒ Science and Technology 11	❒ Biology 12
❒ Chemistry 12	❒ Forests 12	❒ Geology 12
❒ Physics 12	❒ Applied Physics 12	❒ Other _____

Please choose a Science course that you have taught *within the past two years* and answer the following questions.
(Please complete a separate questionnaire for each Science course that you would like to have input into for the review process.)

Please indicate the IRP that you are responding to: _____

2. **Prescribed learning outcomes** (PLOs)are content standards for the BC education system. They set out the knowledge, enduring ideas, issues, concepts skills, and attitudes for each subject. The PLOs are statements of what students are expected to know and do at an indicated grade.

In general, the wording of current PLOs is	❒ appropriate as is ❒ vague and requires more specificity ❒ too detailed and requires less specificity ❒ inconsistent ❒ very inconsistent and requires significant revision
The number of PLOs in the IRP is	❒ appropriate to cover the content/topic ❒ excessive ❒ insufficient to cover the content
To what extent do the PLOs of this IRP guide your lesson planning?	❒ always ❒ mostly ❒ somewhat ❒ not at all
The PLOs are grade appropriate	❒ strongly agree ❒ agree ❒ disagree ❒ strongly disagree

Comments about PLOs _____

_____

_____

_____

3. Are there topics of study that you would like to see changed, added or deleted from this IRP/course? ❒ Yes ❒ No

Please identify each topic and explain why the change should be made: _____

_____

_____

_____

_____

_____

4. Please name the **principal learning resource(s)** that you use for this course.

_____

_____

5. a) Are you familiar with the Grade Collections of recommended resources for this course? ❒ Yes ❒ No

   b) Do you feel that there are sufficient resources to complement this course? ❒ Yes ❒ No

   Comments_____

6. What are the factors that determine the content of your Science teaching? (*Please mark all that apply*.)

   ❒ topics in the IRP ❒ student interests ❒ topics in the textbook

   ❒ student knowledge ❒ equipment availability ❒ current events

   ❒ my interests ❒ other _____

7. The general curriculum organization (life, physical and earth and space Science) is appropriate for Science 8, 9 and 10.

   ❒ Strongly Agree ❒ Agree ❒ Disagree ❒ Strongly Disagree ❒ Not Applicable

   Comments_____

8. The suggested ***Instructional Strategies*** are useful.

   ❒ Strongly Agree ❒ Agree ❒ Disagree ❒ Strongly Disagree ❒ Not Applicable

   Comments_____

9. The suggested ***Assessment Strategies*** are useful.

   ❒ Strongly Agree ❒ Agree ❒ Disagree ❒ Strongly Disagree ❒ Not Applicable

   Comments_____

10. Identify the information and communication technology that you use in your teaching. *Please check all applicable responses*.

   ❒ administration of data (handout preparation, marks gathering etc.)

   ❒ communication via e-mail with Science colleagues (inside and outside school)

   ❒ using the web to find instructional materials

   ❒ teacher presentations (power point, demonstrations)

   ❒ student use for lab activities (dissections, probeware, graphing, simulations)

   ❒ student use for accessing information for research projects (internet, Web resources, reference CDs)

   ❒ publishing of student projects on the Web

   ❒ student use for word processing

   ❒ Science software. Give examples _____

   ❒ Other _____

11. Please any barriers which hinder you or your school from delivering this Science course.

❒ lack of background knowledge ❒ lack of enough class time ❒ lack of Science equipment

❒ lack of textbook/resources ❒ lack of teacher in-service ❒ lack of enough prep time

❒ lack of student interest ❒ lack of expertise in this subject ❒ Other _____

12. Are you familiar with the Ministry of Education Science Safety Manual? ❒ Yes ❒ No

13. Do you integrate Aboriginal content into your Science program? ❒ Yes ❒ No

If yes, please indicate what you do. _____

_____

If no, what would assist you to integrate Aboriginal content in your Science program?_____

_____

14. What suggestions/concerns do you have about Science in BC? Please consider this from the perspective of the Classroom, School, District and Ministry of Education?

_____

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☺ Thank you for completing this questionnaire.

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Please return it to Darlene Monkman, Science Curriculum Coordinator, British Columbia Ministry of Education

BY FAX: (250) 387-1527 OR BY MAIL: PO Box 9152 Stn Prov Govt Victoria, BC V8W 9H1

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