

# Keeping Curriculum Current in Canada

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## Introduction

The Norman B Keevil Institute is one of Canada's leading mining schools. It has an annual intake of 50–60 undergraduate students of which roughly 25% go on to work as mineral processors.

Its mission is to educate world-class professionals and researchers, preparing students for leading roles within the global mining industry.

There are many factors involved in keeping the curriculum current, some of which are outlined below.

These include:

1. Recruiting good students
2. Providing the right balance between general and specialist skills
3. Teaching the right topics
4. Staying relevant and up to date
5. Initiating research which is equally valuable to industry and academia
6. Managing a global focus
7. Encouraging life-long learning

## Recruiting Good Students

Attracting good students, although challenging, is fundamental to the success of a department. It has been noted that undergraduate recruitment follows industry cycles. During industry downturns the grade average of students applying for entry into the program goes down, and this reverses during good times when the department is able to attract students with much higher grades.

Much of the undergraduate program at the Keevil Institute is common to all students, whether they be in the mining, processing or environment streams. Mining is preferred by the majority of students, indicating that a career in at the mine is more attractive to them than a career in the concentrator. This may be because mining engineering groups have done a better job in communicating the benefits of a future career to students.

Recruitment remains a major focus of the departments activities.

## Generalist Versus Specialist Skills

The Keevil Institute's Industry Advisory Committee was consulted on his issue. At the undergraduate level, it is important that degree programs develop a generalist who has the ability to become a specialist.

## Teaching the Right Topics

The modern mineral processing industry is reliant on many sophisticated tools, which graduates need to know how to manage and use effectively. These include software, instruments (both on and off-line), sensors and analytical devices.

Learning to use these tools is important, but students also need to understand the underlying fundamentals, so that when they turn the expert system off they still know how to run the plant.

Programs are accredited by the Canadian Engineering accreditation board. This group is interested in both the technical content of courses but also

other skill sets being developed by graduates, such as communication, creative thinking and teamwork skills.

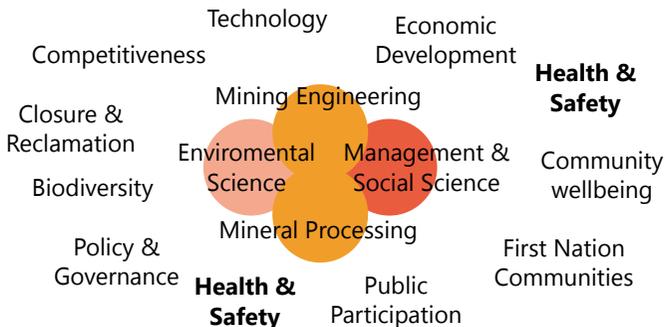
Specific Mineral Processing courses include:

- Processing Mineralogy
- Mineral Processing I (Introduction)
- Mineral Processing Unit Operations
- Flotation
- Automation and Process Control
- Advanced Processing Mineralogy
- Coal Preparation
- Processing of Precious Metal Ores
- Oil Sands

The Keevil institute also takes a strong interest in issues relating to sustainability and environmental stewardship. The school is affiliated with the Canadian Network for Sustainable Mining, and states that “as a mining school we assume the responsibility for a learning and research environment that generates highly qualified people, new technology and innovative practices that will enable the world to achieve a sustainable future”.

Sustainability themes are threaded through the curriculum. For example, students learning about Bond Work Index learn at the same time about energy efficiency issues as they apply to comminution.

**Figure 1: Education and research map showing four sub-discipline research groups**



Education and research is organised according to the four sub-discipline research groups of mining, mineral processing, environment and management/Social Science (Figure 1). This ensures that graduates receive broad exposure to all aspects of mining, hopefully minimising the “silo” mentality so often criticised in the industry.

## Staying Relevant and Up to Date

First and foremost the teaching faculty need to stay relevant and up to date. This is managed in several ways, and facilitated by members of the Institute’s Industry Advisory Committee. Regular interaction between academic staff and industry ensure a strong focus on industry-relevant content.

The Keevil Institute introduced an industry exchange program, known locally as a “Co-op program”, in the late 1990s, where bachelors students spend 12 months in industry during their studies and masters students take 4 to 8 month internships. They undertake constructive, relative, paid, technical engineering work with approved industry organizations. In many cases interns are considered by employers for fulltime employment.

When this program was introduced there was an immediate and notable change in the level of discussion in the classroom as students shared knowledge and information, despite the fact that not all students had co-op experience. The direct exposure to practical mineral processing grounded the program. Partners involved in the co-op program (see the example in Table 1) have become partners in education as well.

**Table 1: MEng internship partners**

MEng Internships
Barrick Gold
CESL Research
Cliffs Natural Res.
Eldorado Gold
Golder Associates
Grande Cache Coal

Imperial Metals
Imperial Oil Inmet
Kemetco Research
Metso
Myra Falls
New Gold
Northgate Minerals Pan American Silver
Rio Tinto
Suncor Energy Inc.
Syncrude
Taseko Mines
Teck Res. Corp
Vale Inco
Wardrop-TetraTech
Yukon Zinc

There is also strong support from Canada's professional societies, the Canadian Institute of Mining (CIM) CIM and the Canadian Mineral Processing Society (CMP). CMP pays for 2 students from every program in Canada to attend their annual meeting, providing them with an opportunity to meet with industry professionals and hear them talk about their most pressing current technical challenges.

## Research

Mining industry research is important for the industry as well as for University departments. The mining industry, although modernising, is not the most modern of industries and is often criticised in the popular media. This poor public profile creates considerable pressures, which can be mitigated by research and development.

Most academics enjoy research, because it is collaborative, interesting, and tackles authentic problems. The challenge is attracting funds. The Keevil Institute employs a two-step process that ensures research is valuable to

industry and to academia. The first step is to approach an industry partner for support, and this requires a proposal that addresses an issue that the partner is prepared to spend money on exploring. Once topics and timelines have been agreed, the Institute applies academic guidelines and develops a submission for University funding. This two-stage approach ensures that research is relevant to industry and also meets the rigid academic standards set by Universities and research funding bodies.

- Mineral Processing research topics include:
- Flotation
- Coal Preparation
- Recycling and Resource Utilization
- Comminution
- Physical Separation (Gravity Concentration, Preconcentration)
- Rheology
- Solid/Liquid Separation
- Oil Sands Processing

Research activity supports relevance in the curriculum and feeds back into teaching. The impact of high quality and relevant research in a department is far-reaching. Modern, well provisioned laboratory facilities enrich the practical aspects of programs and direct work on relevant programs improves the passion and engagement of teaching faculty.

## Global Focus

The Keevil Institute's mission is to educate world-class professionals and researchers, preparing students for leading roles within the global mining industry.

Mining industry professionals all work internationally. The Keevil Institute's programs teach both domestic and international students and graduates work all around the world. The undergraduate programs are made up of approximately 25% international students, which increases to 75% in postgraduate level programs. Maintaining a diverse international culture ensures that students and faculty stay

Students see the international focus as a positive aspect of programs, and prospective students are attracted by the opportunity to work all over the world.

## Encouraging Lifelong Learning

Education programs go beyond conventional undergraduate or postgraduate degree programs and the Keevil Institute stays engaged with mineral processors and metallurgists in industry via a number of professional development programs.

There are many reasons for professional development programs. They provide an accreditation pathway for chemical engineers or others who want to work as mineral processors, and can also provide training in use of new tools such as modelling and simulation packages, or process control technology

The Keevil Institute's Professional Development offerings include

- Master of Engineering (co-op) currently 45 students – completion in 21 months, course-based, co-op options
- Certificate in Mining Studies – Continuing Studies – currently 250 students

## Conclusion

The Norman B Keevil Institute successfully produces 50 to 60 world-class mining industry professionals and researchers every year, many of whom take up leading roles within the global mining industry. It does this by attracting good students and developing them in partnership with the industry which will ultimately employ them.

Curriculum is regularly reviewed to ensure that students have relevant skills and knowledge of core topics, underpinned by general professional skills and exposure to the practical aspects of the industry including the broader social and environmental context in which they will be working..

