

# C<sub>3</sub> News

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Newsletter of **College Chemistry Canada / La Chimie Collégiale au Canada**

## YUKON HO!

In this issue you will find an article on things to do in the Yukon. This issue focuses on the energetic activities, the next issue will highlight some not so strenuous activities. You will also find the preliminary call for papers. Our conference coordinators are anxious to get the program together as early as possible so send in those abstracts now, before the program is full.

### Experience the Yukon

- Part 1 - *The Energetic Version*  
Bob Browne - Douglas College,  
New Westminster, B.C.

If you have never visited the Yukon, and you're going to pay the big bucks to come to the conference, then you should plan to take advantage of some of the local attractions, experience the wilderness, or take some day trips while you are here. Here are a few suggestions, and some addresses where you can get more information. If you are interested in any of these activities, and would like to get in touch with others considering the same outing, I can act as a clearing house.

#### 1. Hiking

##### *The Chilkoot Trail (3 to 5 day hike)*

Billed as the longest museum in the world (33 miles) the Chilkoot Trail follows the path of the gold rush stampeders in the winter of 1897/98 as they struggled over the mountains from Dyea, Alaska (9 miles north of Skagway), to Bennett Lake B.C. Strewn along the way are structures and artifacts left behind by this tidal wave of humanity. The trail takes you through coastal rain forest, alpine tundra and into a subalpine boreal forest on the descent into Canada. The highlight of course is the scramble over the summit where the gold rush miners climbed the

1350 steps of the "golden stairs" with their ton of provisions.

Parks Canada takes great care to warn prospective hikers of the dangers of the trip...bad weather and the long strenuous climb over the summit, but the scenery is truly spectacular, and the historical significance of the journey makes it unique.

This is not a wilderness journey. You share the trail with other hikers, and will often see them again at the end of the day at one of the ten designated campsites. As the anniversary of the gold rush approaches (1998), this hike will become more and more popular, and Parks Canada is considering instituting a reservation system so it would be advisable to contact Parks Canada well in advance of your hike. For more information write to:

Area Superintendent  
Yukon National Historic Sites  
Canadian Parks Service  
205-300 Main Street  
Whitehorse, Yukon Y1A 2B5  
(403) 667-3910

#### *Kluane National Park*

Kluane National Park, located in the extreme southwest corner of the territory, contains within its borders the highest mountains in Canada (including Mt Logan at 19,525 feet) and the most extensive non-polar ice fields in the world. Together with the neighbouring Wrangell-St. Elias National Park in Alaska, it has been named as a United Nations World Heritage Site and is protected under the UNESCO World Heritage Convention as containing wilderness areas of global significance.

Because it was created as a wilderness park, only basic facilities exist, and no

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## C<sub>3</sub> Business:

### The C<sub>3</sub> Award:

A reminder, nominations must be received by January 1 of 1996. Don't let this award go unrewarded yet again. Look around you, who do you know who is deserving of this award? See the Fall issue, or our internet home page, for a review of the guidelines.

### Membership Renewal:

Please check your mailing label for your membership expiry date. If your membership has expired Bob Perkins is anxiously awaiting your renewal. Remember it is only \$20 per year. New members may join by sending name, address, phone, and e-mail address, and \$20 to the secretary: Bob Perkins.

### Editor's Note:

Hopefully this issue is reaching you sometime in early December, believe it or not your first issue of this academic year should have been in your mailbox by mid September, not mid October. Due to the ever increasing production problems we have been experiencing at O.L.A. this issue was produced and published at Kwantlen University College. Thank to the printshop at K.U.C. for providing speedy service, and to Alan Davis at O.L.A. for continuing to provide the postage and mailing services to us, and for all his efforts in the past in ensuring the newsletter was produced.

**Wanted:** One creative individual, capable of procuring newsletter submissions. Useful experience include: strongarming, coercion, begging. You are familiar with some form of desktop publishing or know someone that is. You are willing to devote two years of your life to provide stimulating and informative reading to the membership of College Chemistry Canada. Yes the position of Editor will be open next year. If you are interested in the position please let the executive of C<sub>3</sub> know.

### Regional News from Ontario:

The school of Biological Science and Applied Chemistry - Seneca College (North York) is moving to a new state of the art building at York University (North York) in Sept. 1997. The building which costs approximately 60 million dollars was funded by the provincial government, and expected to be a show case. Perhaps we can host the annual C<sub>3</sub> conference at the new location upon finishing in the summer of 1998.

There were two new French Community Colleges born in Ontario which opened this summer. In Ontario there are now 25 community colleges.

George Grant, Prof. at Seneca College completed his doctoral studies at the University of Toronto on Sept. 12, 1995. His thesis title: Occupational Stress Among College Educators. George Grant and Dinesh Bhatnagar are the C<sub>3</sub> regional directors in Ontario.

Seneca College - School of Biology and Chemistry have an agreement with both Guelph University and York University to take students after their 3 years at Seneca for an extra year and a half to complete their Bachelors Degree. Seneca graduates are currently enrolled at Guelph to complete their degrees.



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Articles of any length will be gladly accepted. Please send typewritten copy to the editor at the above address or send by fax or e-mail. Copy can also be sent on a 3 1/2" disk, IBM format using Word 6.0 or any word processor producing ASCII output.

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## Experience the Yukon (cont'd)

(Continued from page 1)

highways cut through the park. There are two visitor centres accessible from the Alaska highway: the Haines Junction Visitor Centre is open year-round and has information on trails and wildlife activity, exhibits, and a thirty minute AV presentation on the park; the Sheep Mountain Visitor Centre, located 71.5 km north of Haines Junction, serves the northern end of the park. Its interpretative program concentrates on the Dall sheep found in the area. A number of campgrounds accessible by car can be found along the park border including the Kathleen Lake Campground maintained by the Canadian Parks Service throughout the summer.

Apart from the aforementioned camping on the borders of the park, there are only two ways to really see it: fly over it, and hike in it. A number of air charter companies operating from Whitehorse or Haines Junction will fly you over the ice fields on 1 to 2 hour excursions. Hikes into the park range from half-day hikes to 10-12 day back pack trips. For more information on Kluane Park write to Tourism Yukon, P.O. Box 2745, Department 5037, Whitehorse, Yukon, Y1A 5B3.

### 2. Canoeing/Kayaking

#### *The Yukon River*

If you have ever stood on the banks of the Yukon River as it glides silently by, you cannot help but be captivated by it. In many ways, the Yukon River IS the Yukon and its history is the history of the territory. There is simply no better way to get a sense of the Yukon than to spend a week canoeing on it. When the stamperers built their boats at Lake Bennett during the winter and spring of 1898, the ice broke up on May 29 over 7000 boats set off for Dawson and the gold fields.

As you paddle (or drift, the current is 10km/hr in many places), you watch the shore for bears, moose, goats, eagles, and many ducks. You dip your line in and catch an arctic grayling or northern

pike for supper. And always, the sky, the weather. This is a land where the forces of nature must be respected, you have no choice but to fit in. Most of the scars left by the gold rush have healed, although they say it will take another 200 years, the evidence is disappearing fast. The riverboats used to require two cords of wood per hour, and there were around 250 of them at the peak of river travel. That means that there was a lot of wood cut from the slopes. Today, the only evidence of these wood lots is that the dark green of the coniferous trees have been replaced by light green poplars or alder. The landings and settlements have all been marked and you can spend lots of time looking through and around ruins. Fort Selkirk is an exception: it is being slowly restored by Parks Canada, although many of the houses are sitting the way they were over 100 years ago.

The trip from Whitehorse to Dawson is 460 miles (740 km) and will take up to 16 days, but can be cut in half by either starting or ending at Carmacks. An excellent series of river guide books, in-

cluding ones for the upper and lower Yukon, have been written by Mike Rourke. Copies can be obtained from the publisher: Rivers North Publications, Box 151, Houston, B. C. V0J 1Z0)

#### *Other Rivers*

But there are many other rivers worth exploring: the **Teslin**, the **Big Salmon River**, and the **Nisutlin River** are all class I/II rivers and require no white water experience. If you are a white water addict, there are more than enough challenging rivers to keep you happy. (See "Rivers of the Yukon: A Paddling Guide", by Ken Madsen and Graham Wilson. Copies of this book may be obtained directly from the publisher: Primrose Publishing, 21 Klondike Road, Whitehorse, Yukon, Y1A 3L8)

There are a number of outfitters who rent canoes and equipment, and conduct guided adventure tours. The Kanoe People, located on the river in downtown Whitehorse, not only rent a wide variety of canoes and kayaks, but will supply stoves, coolers, camping equipment, and transport you to/from your starting/takeout point. (Kanoe People, P.O. Box 5152, Whitehorse, Yukon, Y1A 4S3, phone: (403) 668-4899; fax: (403) 668-4891).

### Latest From the Literature.....

*Sudhir B. Abhyankar, Sir Wilfred Grenfell College, Corner Brook, NF, A2H 6P9*

1. An excellent review of four transuranium elements has appeared in the *Accounts of Chemical Research*, vol. 28, no. 6, 1995, page 257. In the review, Glenn T. Seaborg has summarized the chemistry of Plutonium, Mendelevium, Seaborgium (there is some controversy over the naming of this element) and element number 110. The review has a lot of interesting information which can be used in the classroom.
2. Chemistry conferences on the internet have arrived. In an article published in *Chemical and Engineering News*, August 21, 1995, page 35, details of the first Electronic Conference on Trends in Organic Chemistry (ECTOC-1), which ended in mid-July can be found. This electronic conference is treated as any other conference and papers are subject to peer review. Contributions to this new conference, either papers or posters, are regarded as genuine scholarly work and are abstracted in the usual way by various abstracting agencies.
3. A review of the objectives and types of laboratory work in chemistry is reported in a paper published in the *Australian Science Teachers Journal*, vol. 41, no. 2, page 26. It offers a constructive criticism of current practices. The paper concludes that an increased emphasis should be placed on the development of students' science investigation skills.

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## Problem Solving Strategies for Pharmaceutical/Chemical Technology College Students

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### INTRODUCTION

Problem solving is the mental process used to arrive at an optimal solution to an unknown situation subject to a set of constraints (1). Problem solving skills include a knowledge base pertinent to the content of the problem; the ability to locate, identify, obtain and evaluate missing information; cognitive skills to analyze, reason, classify, and establish relationships; attitudinal skills to cope with ambiguity, fear, anxiety, procrastination; and the ability to use creativity and intuition along with analytical reasoning to reach the optimal solution to a given problem.

Instead of encouraging the students to memorize facts or ideas by rote memorization (called the expository method) just to pass tests and exams; educators should focus on teaching problem solving skills as early as possible. Helping students to develop and organize, hierarchical knowledge based on understanding (called the discovery method) will undoubtedly help their cognitive domain not only to cope with course work, but to thrive later in their chosen careers.

Educators of every philosophical persuasion, and from diverse background all agree about the importance to teach problem solving skills to their students, although they may differ about the way in which this goal is to be accomplished. Educators can help students recognize that problem solving does not progress in a simple straight forward fashion from problem to solution. They can show that it is possible to use more than one method to solve a given problem. They should teach students to break a problem down into manageable components. They can help students develop a plan for solution,

including the skill to use approximation. Problem solving skills can be taught in any subject curriculum and not as a separate course.

### REVIEW OF LITERATURE

A complete review of the literature is available from the authors.

### METHODOLOGY

The freshman chemistry class was divided equally into two groups at random, where one group (test) of 22 students was given strategies to enhance their problem solving skills and the other group of 22 students (control) was not instructed and used for comparison.

During a one hour long lecture, the test group was given the strategies for problem solving using the following key steps:

#### Problem

Plan for the problem solving process by drawing pictures.

Relax when faced with the problem to allow for clear thinking.

Overcome any fear when dealing with the problem.

Breakdown the problem into small manageable components.

Look back for any missing information in the problem statement.

Evaluate ways (forward/backward) to solve the problem.

Measure all possible logical ways to solve the problem.

#### Solving

Select the most apparent logical solution to the problem.

Organize your thought to reach an optimal solution.

Locate another possible solution to the problem, if any.

Validate and verify the reached solutions.

Inspect all possible solutions and choose the optimal one.

Never give up persist until you reach the solution.

Go celebrate, you have reached a solution to the problem.

It was emphasized to the students the importance of the planning stage since the majority of the students try to avoid initiating the process and they simply panic not knowing from where and how to start the process. Drawing pictures was an effective method of planning. The second step (relaxing) was crucial for clear and creative thinking as reported by Ross (2). The next step was to help students overcome fear when faced with ambiguity which are inhibiting factors in the process of problem solving. Breaking down the problem into small manageable components was an important step particularly in solving mathematics or chemical calculation problems. The students were instructed to look back for any missing information in the problem statement without which the process of problem solving would be difficult if not impossible. The next step was the evaluation step where the student can look at the problem and decide whether to solve it forward or back ward using analytical reasoning. The students were told that every problem should be evaluated differently and not to expect identical solution paths for all problems. The following step was to help the students measure all possible logical ways to reach an optimal solution for the problem. The students were instructed to be patient going through the previous steps and not to expect an instant solution rather than going step by step through the process until they are fully familiar with the problem and ready to reach the optimal solution.

The next step in the process of the problem solving is to focus on the solution and select the most logical solution after carefully assessing the problem. At this point the students were asked to organize their thoughts to reach an optimal solution through creative and logical thinking as

*(Continued on page 5)*

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well as using techniques such as brainstorming to search for that idea which may not be obvious through traditional ways of thinking. To locate other possible solutions was an important step in reaching an optimal solution since many problems may have multiple solutions from which only one is considered ideal. The students were shown how to validate the solution in order to verify the fit between the solution and the problem. This is a vital step in science and mathematics types of problem solving. The next step was simply to inspect all possible solutions and decide on the optimal one. During the lecture one key aspect of the process of problem solving which was emphasized was persistence, particularly for first year students. The last step after reaching the optimal solution was to go and celebrate and all students did not have any difficulty with this step.

Both the test and control groups were given five basic mathematical problems to test the difference in their abilities to perform the problem solving strategies. (Appendix 1)

The student's t-test was used to determine the validity of the null hypothesis ( $H^0 : X1 - X2 = 0$ ) (no difference in test score after learning problem solving strategies) or the alternate hypothesis ( $H^1 : X1 - X2 \neq 0$ ) (there was significant difference in test scores between the two populations) using tow tailed test at 95% probability level. The degree of freedom (df) =  $n1 + n2 - 2 = 42$

$$t = \sqrt{\frac{X1 - X2}{\frac{sd1}{n1} + \frac{sd2}{n2}}}$$

## RESULTS

The ability of the students to solve the given five basic mathematical problems from the test (trained) and control groups can be summarized in table 1.

**Table 1:** % of students who successfully completed the solution of basic mathematical problems.

	Test Group	Control Group
Problem 1	72	67
Problem 2	56	41
Problem 3	65	57
Problem 4	74	63
Problem 5	61	50
Average (X)	65.6	55.6
Standard Deviation (sd)	7.5	9.2

$$t = \sqrt{\frac{65.6 - 55.6}{\frac{7.5}{5} + \frac{9.2}{5}}}$$

$t=1.89$  which is less than 2.02 (Df=42), therefore there was a significant difference at the 95% probability level. As a result, the null hypothesis was rejected and the alternate hypothesis was accepted, which suggests that teaching problem solving strategies improved the student's abilities to solve problems.

Although the first problem was answered successfully by more than two thirds of the students, in both test and control groups; it was surprising to see that most students had difficulty with the second problem. In the third problem only a few students were able to reach both possible solutions, but the majority were able to reach the first obvious solution. ( $13 \times 1=13$ )

Since basic mathematical skills are essential in the learning of chemical calculations (3). The test was also used as an assessment tool for the student's knowledge in mathematics and the results were shared with their mathematics professor for a remedial action. The five problems were used as a problem solving tool to evaluate the degree by which the students were able to apply the basic problem solving steps, learned among the test group.

The students indicated that they needed to practice the steps of problem solving and asked for more problems in mathematics and chemistry to try which was an encouraging sign. Most students from the test group found that the planning stage was the most valuable step.

Examination scores for the chemistry midterm was 7.5% higher than the control and failure rate (lower than 56%) in test score was lower in the test group by 5% as compared to the control. These results were also found to be significant at 95% probability level, which may suggest that learning and practicing problem solving strategies may influence the student's success, assuming that no other variables had any influence on both the test and control groups.

Therefore we can conclude that when problem solving strategies are embedded into a science and mathematical curriculum, it can have a significant contribution towards a student's success.

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**CONCLUSION**

When a class of college freshman students were divided into two groups, one group was taught the strategies for problem solving and the other group was used as a control, the ability of the test group to solve basic mathematical problems were better than the control group and was significant at the 95% confidence level. It can be concluded that teaching problem solving strategies help students improve their performance and increase their confidence level to cope with problems at the college during their studies and/or after graduation when they join the real world.

**APPENDIX 1**

1. Determine the pattern. Find the missing number in figure 1

9	8	20	3
16	4	32	12
15	9	29	5
23	13	50	14
9	12		16

Figure 1. Problem #1 (Answer 37)

2. Determine the pattern. Find the missing number in figure 2

25	52	31	26
9	4	7	5
38	28	18	19
7	20	7	

Figure 2. Problem #2 (Answer 9)

3. When a single digit number is multiplied by a double digit number a double digit number results. The sum of the three numbers is 27. What are the three numbers?

Two answers ( $1 \times 13 = 13$ ) or ( $-3 \times -15 = 45$ )

4. The sum of two consecutive numbers is 225, find the two numbers. Answer (112 and 113)

5. Fill each square in figure 3 with a number from 1 through 9. Horizontal squares should add to the totals on the right, vertical squares should add to totals on the bottom. Diagonal squares through the centre should add to the totals in upper and lower right.

—	—	—	—	24
			6	32
7				17
		3		22
	8			19
32	34	13	11	22

Figure 3. Problem 5

—	—	—	—	24
9	9	8	6	32
7	8	1	1	17
8	9	3	2	22
8	8	1	2	19
32	34	13	11	22

Figure 4, Solution to problem 5

**References:**

- (1) Hayes J.R., The Complete Problem Solver, Hillsdale, N.J. Erlbaum, (1981).
- (2) Ross, M.B. "Creativity and Creative Problem Solving." in J.W. Pfeiffer and J.E. Jones Annual Handbook for Group Facilitators. Iowa City, Iowa: University Associates, (1981).
- (3) Lythcott, J. "Problem Solving and Requisite Knowledge of Chemistry," Journal of Chemical Education, 67,3 (1990), 248-252.

**Latest from the Literature...** (Continued from page 3)

4. The conceptual difficulties chemistry majors face in understanding distillation is the subject of an article, "Teaching and Learning Distillation in Chemistry Laboratory Course", *Journal of Research in Science Teaching*, vol. 32, no. 7, 1995, page 715. The finding of the research paper indicates, among other things, that students do not have sufficient understanding of the properties of vapour.

5. A very simple recipe for whitening old newspaper clippings is described in the *Journal of Chemical Education*, vol. 72, no. 7, 1995, page 651. The recipe requires a saturated solution of calcium hydroxide and a 1% aqueous solution of sodium borohydride, NaBH<sub>4</sub>.

6. A brief history of the development of antibiotics, their mode of attack, and resistance are some of the major features of an article, "The Antibiotic Era", *Education in Chemistry*, vol. 32, no. 7, 1995, page 94. This article provides a brief but updated summary of recent advances in the field of antibiotics.

## CRITICAL COMMENT CORNER (CCC)

Bob Perkins, Kwantlen University College

Here we go again since no one else has picked up on my suggestion to send something of a controversial nature in to Suzanne.

### Multiple Choice Questions -Should They Be Banned In Chemistry?

Here's the situation! Your time as an instructor is becoming increasingly compressed with the demands of the job. Course revisions, letters, phone calls, committees .... the list is endless. How can you fit everything into the time available? Many of us have seen the trend coming with the latest versions of the textbooks being pushed by the book companies. Nearly every text comes complete with a "test bank" of questions, usually in text format, but increasingly on disk (and soon on CD). The speil from the book rep is that "this is the greatest thing since sliced bread". Your exam preparation will occupy a much smaller part of your day because all you will have to do is push a button, and out pops your exam. Marking can be performed in minutes using a scanner, or a quick visual scan (or better yet, have the students mark their own) of the responses to the 25, 30, 50, 100 .... multiple choice questions that you decide to use for the particular topics that you wish to cover on that exam. I am not opposed to the use of multiple choice questions, my concern is what is being tested on an exam composed entirely of such questions.

Our society is becoming more and more complex, and I believe that our primary mandate is to prepare our students to face that complex future. The Business Council of British Columbia recently published the results of a survey from just under 100 employers in the province. The questionnaire dealt with the attributes desired in potential employees. A basic foundation in math, science, and communication skills was found to be critical in virtually all responses. Also high in the listing were such things as: ability to analyze and

evaluate, willingness to keep on learning, creativity and cooperative problem solving skills. Multiple choice questions can evaluate such skills, but the questions have to be very carefully constructed. Too much of the material that I have seen simply involves recall of information, the lowest level of educational outcome (cast your minds back to Bloom's Taxonomy for those of you have taken some courses in educational theory). I firmly believe that a student should have to think, analyze, evaluate, etc ... to take an exam. If recall is all that is necessary for the student to do well then you are not really setting an exam. As I sit here typing this, an article in the latest issue of the Journal of Chemical Education (Sept 95, ppA181) laments the availability of the "Sharp Electronic Organizer". Information can be stored in this pocket computer which would seriously disadvantage any student without similar computing power. This is only a problem if the exam is largely "multiple-choice recall" in its format.

We are now well into the fall semester (by the time you read this we will be well into Xmas exams), and some of our students are struggling with the realization that most of their science exams at Kwantlen University College will not be of the multiple choice variety. The other shock is that for most of the courses, a formula sheet is provided for an exam. For example; in physics, a student is allowed to bring in a one page sheet of any formulas (which is handed in with the exam) which they feel might be of benefit to that particular section of the course. Many students soon discover that having the equations is only the start, careful analysis of the particular situation must occur before any numbers can be dumped into the calculator. A similar policy in the course where we cover thermodynamics, I provide a sheet at the beginning of the semester of all the equations needed for the course. This sheet is also attached to all the exams. I am more interested in testing whether the student understands how (and when) to use a particular equation rather than if they have memorized what the equation is. The same is true

for the first year course where I introduce organic chemistry. On every exam I provide a listing of the prefixes and suffixes of the common functional groups, along with their priority for naming. In this way I am determining if the student understands how organic nomenclature is used rather than if they have memorized whether C<sub>2</sub>H<sub>4</sub> is ethane, ethene, or ethyne.

Testing memorized facts is easy. Should we not also be concerned that the students are aware of where the information came from? Once students leave your classes they should be able to "look up" facts if needed. As part of the preparation, I bring in copies of the Merck Index, CRC Handbook, and Aldrich chemical catalog to my classes. For example, if physical data is required for a discussion of boiling point trends of organic compounds, I have the students find the information themselves. Students are initially frustrated as the material is organized in different ways in each handbook. By the end of the semester; however, all the students are much more confident about finding material from one of the handbooks. I also make use of the Periodic Table database program from the Journal of Chemical Education to allow the students to "discover" periodic trends on their own.

Multiple Choice Questions -Should They Be Banned In Chemistry? My answer to the question is a yes if evaluation of the students is based entirely on them. My answer is a no if they only make up a small part of the evaluation. Questions should be designed to allow the students to demonstrate what they have learned (understood) rather than memorized without understanding. The crunch comes when you are faced with classes of several hundred. Happy testing (and marking)!!

On a similar vein see "The Physics Teacher" volume 31, Jan. 1993, p.8.

So do you agree with Bob? Do you disagree with Bob? Either way state your case and send in your opinions. Or do you have a different pet peeve? Let us know.

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