PLANNING AND EVALUATING A MATHEMATICS CAMP FOR GRADE SIX STUDENTS

by

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PLANNING AND EVALUATING A MATHEMATICS CAMP FOR GRADE 6 STUDENTS

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Abstract

The purposes of this study were to develop a framework for planning and organising an outdoor mathematics camp for a group of elementary students, conduct the two and one-half day camp, and measure the effect the camp had on the students' attitudes to mathematics.

Informal discussions were held with the teachers on all aspects of the camp. Training was also provided for six Grade II students who were selected to act as counsellors at the camp. The training covered leadership, role modelling, facilitating cooperative problem solving, and specific duties and responsibilities.

The camp, held over a period of two and one-half days in April, 1992, involved 52 Grade 6 students from one school. Activities at the camp were selected for mathematical content and inherent interest for the students. Students were assigned to teams of four and were encouraged to work cooperatively and non competitively either within or between the teams. On the first day teams were assigned specific activities; on the second day they were assigned sets of activities from which they could select the ones which they found most appealing. For the final activity each team
attempted to design an original problem which could be used at a future camp.

Student attitudes to mathematics were measured before and after the camp using questionnaires designed specifically for the purpose. Data were also gathered from a camp evaluation form completed immediately after the camp, from students’ portfolios, and from observations and discussions with the grade 11 camp counsellors and the staff who attended the camp. Parents also filled out questionnaires measuring their perceptions of their children’s attitudes to mathematics before and after the camp. The quantitative results indicated that the camp had no significant effect on students’ attitudes to mathematics; the qualitative analysis, however, suggests some slight increase in the students’ interest in problem solving and mathematical processes.

Student counsellors and staff unanimously agreed that the camp was a success and should be repeated annually. All felt the students enjoyed most mathematical activities and the total experience of camp life.

It is concluded that many of the mathematical experiences from the camp should be incorporated into regular class procedures and this could be helped if camps were run for teachers.
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CHAPTER ONE

THE PROBLEM

There is a widely held view that the educated citizen of the future will have to be able to think critically, creatively and reflectively. There is also an opposing view which argues that the majority of citizens will need no such skills for their future roles as dispensers of hamburgers or other "service" industry jobs of the future. The latter view focuses only on a narrow range of occupations and does not consider the need for the adult population to acquire the skills needed to contribute successfully to all aspects of society.

As a teacher of mathematics with many years experience I have become more and more convinced that, for the sake of the students, the teaching of mathematics must change from the traditional "drill and practice" format. I am certainly not alone in this view that critical thinking and creativity must become part of the teaching and learning of mathematics. Most mathematics curricula today emphasise critical thinking and problem solving along with communication and cooperative work skills as being essential requirements for the educated citizens of the 21st century (B.C. Ministry of Education, 1992a, 1992b; National Council
of Teachers of Mathematics [NCTM], 1989). According to this view, if students entering the work force in the next ten to twenty years are to be successful, they will have to be able to analyse information, to think logically, to design models and to create and solve problems (NCTM, 1989). This means that students whose mathematics education comprises little more than learning a series of facts and acquiring skills which can be applied only in routine repetitive situations are being inadequately prepared for success in the work place.

The provision of an appropriate mathematics education for all students will probably require a revision of the mathematics curriculum and curriculum materials and a new vision by education authorities, teachers, parents and students of what is meant by mathematics education (B.C. Ministry of Education, 1992a, 1992b; Mathematical Sciences Education Board, 1991). In British Columbia, changes are beginning to take place as a result of the findings of the Royal Commission on Education (Sullivan, 1988). New approaches to teaching and learning mathematics have been outlined in the Draft Curriculum/Assessment Framework for Mathematics (B.C. Ministry of Education, 1992a) and various discussion meetings have been held throughout the province.
The problem is, how do we change both the curriculum and methods of instruction to address the mathematical needs of students who will be graduating in the next ten years? In particular, how can we improve both teachers' and students' attitudes towards mathematics? Perhaps if students can experience mathematics as a way of thinking which can help them to solve problems from their world which exists outside the classroom, then mathematics will become more meaningful to them, thus improving their self-confidence and their ability to achieve success in mathematics.

Such issues, of course, concern mathematics and mathematics education in its broadest sense. The introduction of calculators, computers and other technological aids has decreased the need for students to spend long hours on routine drills. They still need to master the basic skills and procedures but, more importantly, students entering the work force at the end of this century will need to be able to think mathematically. If students can learn to think mathematically they will be able to see relationships and patterns and apply their mathematical understanding and skills to solve problems (Burns, 1990; Peterson, 1988). Mathematics education has to provide the opportunity for students to develop the ability to
solve problems, both routine and non-routine, to communicate concisely, to work cooperatively, to reason logically and to make connections. To do this we have to look at what we teach, how we teach, and the whole learning environment.

Changes in curriculum and changes in teaching methods cannot achieve success unless we can change the attitudes of society to mathematics. We live in a society which requires all its members to become more mathematically literate. Mathematical literacy involves being able to solve mathematical problems, make connections, reason and communicate mathematically (B.C. Ministry of Education, 1992a). Children learn better if they can construct their own knowledge by active participation rather than by being passive consumers of mathematics (Resnick, 1987).

Most adults have a negative attitude to mathematics and have difficulty believing that the study of mathematics could, and should, be an enjoyable experience (Department of Education and Science [DES], 1985; Lewington, 1992). These negative attitudes are often, unconsciously, transmitted to children. Many students see mathematics as an activity governed by memorised rules (Buxton, 1981; NCTM, 1989) which takes place almost exclusively in the classroom; they do not relate mathematics to their world outside the school.
Many consider mathematics as something they do at a set time each day and when the lesson is over they stop using the language, skills and thinking processes they have developed during their study of mathematics. They are not aware that mathematics is a way of thinking, a process of finding patterns, seeking relationships and solving problems. Many, if not most, students, teachers and parents continue to see mathematics as a difficult, confusing, incomprehensible set of rules. This leads to confusion, frustration and anxiety for many students at an early stage in their school career when, in fact, mathematics should be an enjoyable experience (DES, 1985).

If students become anxious or fail to understand some of the mathematics concepts at one grade level then, because of the linear development of mathematics in school, the work in the following grades can become very difficult and the students end up trying to survive by applying rules which do not make sense to them. If students lack the conceptual structures connecting the various strands of their mathematical knowledge, then mathematical understanding breaks down and mathematics becomes a series of illogical, unrelated rules. Mathematics thus becomes a series of step-by-step procedures which students can complete without understanding the underlying
connections. Under these conditions, if students forget the procedures or make mistakes at any point in the process they become lost and lack the flexibility of thinking to be able to remedy this failure and approach the problem from a different direction (DES, 1985). This lack of flexibility also makes it difficult for students to apply their procedures to new and different situations. Children end up accepting mathematics as a series of skills and procedures which can be understood only by other (clever) people.

Personal Background

Throughout my teaching career, I have always felt that students should enjoy mathematics, otherwise learning mathematics becomes more difficult and mathematical knowledge likely to be quickly forgotten. Over the years I have organised Maths Puzzle Nights, Maths Challenges and Maths Competitions for students in Grades 8 through 12. I always felt that if students enjoyed the challenge of puzzles and problems in a different environment this positive attitude would transfer to the mathematics they had to do in the regular classroom situation. Although I never attempted to measure the students' attitudes either qualitatively or quantitatively I felt these experiences did help them.
For many years I have thought it would be an interesting experiment to organise a full day, or better still, a weekend of mathematical activities. Until recently it was never more than an idea. This year, however, a change in my role at the school in which I teach made it possible for me to give serious consideration to the project. For four years until September 1991 I was Head of Mathematics. My role for the 1991-92 year was Coordinator of Professional Development Programs. More specifically, I spent half of my time teaching in the Senior School and the other half as a mathematics helping teacher working with those teachers who were involved with teaching mathematics in Grades 4 through 7. This position afforded the opportunity to have closer contact with teachers and students in the junior grades and the flexibility of my schedule allowed me some time to begin thinking about organising a mathematics camp.

The school’s philosophy with regard to teaching mathematics was in agreement with that of the British Columbia Curriculum; namely, to develop conceptual understanding through the use of concrete materials, to integrate problem solving throughout the curriculum, to relate mathematics to the students’ past experiences and to provide a positive environment for learning. Unfortunately, because many of the teachers in the
elementary grades were relatively new to the school and none of the elementary teachers was a mathematics specialist, the teaching of mathematics has not completely lived up to this philosophy.

During the year of this study, in my role as helping teacher, progress had been made in encouraging teachers to use more "hands-on" materials and teaching via problem solving. For the following year, the school planned to restructure to a format with specialist mathematics teachers in all classes from Grade 5 and higher.

Mathematics Camps as Supplements to the Classroom

One way of providing an opportunity for students to become actively involved in the process of learning while being exposed to mathematics more relevant to their world, is to take them out of the classroom and out of the daily routine of school. A field trip can provide students with a whole new range of stimuli, an opportunity to be active and energetic, and a positive learning experience. Mathematics camps, in particular, can provide opportunities for students to be engaged in a wide range of mathematical activities. Because there are fewer time constraints at a camp, students can spend longer on activities and investigations. They can apply their mathematical
knowledge, skills and strategies to new and interesting situations which are not available in the normal classroom. The outdoor environment also makes it possible to provide them with practical tasks more clearly related to their everyday experiences thus helping them to construct better mathematical understanding, and to become "friendly users" of mathematics. They also have opportunities to work cooperatively with each other and to interact with teachers and other leaders in a less formal atmosphere.

A mathematics camp can also provide opportunities to extend and reinforce many strands of the curriculum. The main focus of the activities of the camp can consist of solving problems, and many of the problem-solving strategies, including designing problems, listed in the British Columbia Curriculum Guide, (B. C. Ministry of Education, 1988) can be incorporated. Also included within the activities could be work from other strands of the curriculum, including the use of calculators, numerical calculations, rounding decimals, geometrical shapes, similarity, transformations, rate, speed, measuring perimeter, area and volume, time, money as well as the collecting, displaying and interpreting data.

Given my outlook on mathematics teaching, the role I played in the school, and the opportunity to
experiment with innovation, I decided that, not only would I organise a mathematics camp, I would use the camp as the basis of an investigation to see if students' attitudes to mathematics would change as a result of the different approach to mathematics fostered by the activities of the camp.

**Purpose of the Study**

There were two main objectives of this project.

1. To provide a rationale and framework for planning, organising, running and evaluating a mathematics camp for elementary students.

   There is little documented evidence of the use of mathematics camps for elementary students. It is intended that the framework developed in this study will be valuable for anyone wishing to replicate the study or for anyone who wishes to organise and run a mathematics camp or even a mathematics day or afternoon.

2. To investigate changes in attitudes toward mathematics of a group of Grade 6 students as a result of attending a two and one-half day mathematics camp.

   If students can be taken out of the classroom and provided with opportunities to be actively involved in investigating problems related to their world outside
the classroom then they may develop a more positive attitude to mathematics which will help improve their self confidence and their ability to achieve success in mathematics.

**Significance of the Study**

Field trips and overnight trips to outdoor school are not uncommon in elementary schools but camps which have mathematics as their focus are, indeed, rare and the camps which have taken place have not, to my knowledge, included any measures of their effects on student attitudes or performance.

This study, which includes the measurement of attitudes before and after the camp, is possibly the first of its kind and is, therefore, worthy of consideration as one way of addressing not only the goals of the *Draft Intermediate Program* (B.C. Ministry of Education, 1992b) but also some of the curriculum intentions of the *Draft Framework Document for Mathematics* (B.C. Ministry of Education, 1992a). These include learning to value mathematics, solving mathematical problems, gaining confidence in mathematical ability, making connections and learning to reason and communicate mathematically.

Since the working time is not restricted to the 40 or 50 minute time slots of school and most of the
activities take place out of doors, the camp can offer students a different perspective on mathematics. Rather than viewing mathematics as a classroom activity students can be given the opportunity to work in groups and to apply their combined mathematical skills to solve problems in a new and different environment. Activities can be designed to emphasise the processes used rather than obtaining "the right answer." Equally important, activities can be selected which are of sufficient interest to the students that they will be motivated to investigate the problem without the threat of a test or exam as the driving force. Evaluation of student performance can be conducted by observations and discussions before, during and after each activity.

Much of what is attempted at camp can be incorporated into current practices inside school. Cooperative learning occurs in many classrooms and evaluation methods which do not require paper and pencil tests are well documented (EQUALS, 1989). These include observations, interviews, learning logs, oral presentations, and projects, together with self, and peer evaluation. Many of the activities from the camp can be used, or modified for use, either in the classroom or in the school yard.

This does not mean that learning essential skills
or developing knowledge and understanding of basic concepts can be ignored. What mathematics camps can provide is the opportunity for students to strengthen their knowledge and understanding of mathematics, to see mathematics as a living, useful tool, and to develop mathematical power. Nor does all mathematics have to be related to everyday situations. Mathematics has value simply because it is intrinsically interesting, intellectually stimulating, aesthetically pleasing as well as functionally useful.

Limitations

Since this seems to have been the first camp of its kind, there are no previous camps from which information, hints, or activities can be gleaned; nor are there sets of data from which comparisons can be drawn. The few camps which have been held were designed mainly for high school students and the camps held in British Columbia were for students with specific mathematical abilities (Chong, 1991; Johnson, 1990). None of these camps conducted quantitative or qualitative evaluations of the students. Nevertheless, discussions with some of the organisers indicate that the camps were very valuable and worthwhile experiences for both students and teachers.

The camp was designed to last two and one-half
days. This could be considered too short a time to have a significant effect on the students when one considers the time it takes the students to adapt to a very different (mathematics) environment, to adjust to working outdoors in groups for longer periods of time, and to generally live together in a large group. The rationale for the two and one-half days was to make it possible for others, who wished to repeat the camp experiment, to do so over the course of a weekend.

A further limitation of the study was that since it was conducted with students from only one school and from one particular grade level the results cannot easily be generalised. This does not, however, preclude the possibility that the results may have implications for other schools and other grade levels. The analysis of the results may also lead to suggestions for further investigations and activities.

**Chapter Organisation**

This thesis contains five chapters. Chapter 1 outlines some of the changes taking place in mathematics and mathematics education and suggests mathematics camps as a possible addition to classroom practices. The two purposes of the study are explained together with the possible significance of the study and its limitations.
Chapter 2 contains a review of the literature on
the need for a curriculum more suited to the end of the
20th Century and the greater need for students to
understand processes and be able to solve problems.
Mathematics anxiety and the need for more positive
attitudes to mathematics are discussed. The last
section highlights the lack of literature on
mathematics camps and their evaluation.

Chapter 3 gives the objectives of the camp
together with details of the organising, planning and
implementation of the camp including the selection of
the mathematics activities. Following this is a
description of the methods used to evaluate the
students' attitudes to camp both before and after the
camp.

Chapter 4 presents the results of the various
assessments carried out during the course of this
study. These include student and parent
questionnaires, camp evaluation forms and discussions
with staff and student counsellors.

Chapter 5 discusses the successes and failures of
the camp and makes some suggestions for changes both in
the camp itself and as a result of the camp.
CHAPTER TWO

LITERATURE REVIEW

There exists a considerable body of literature on the philosophical changes currently taking place regarding the teaching of mathematics. Far less, however, has been written on the practical implications of these paradigm shifts for the teaching of mathematics at the elementary school level. In particular, an examination of current literature reveals very little on mathematics camps and other non-traditional (not classroom-based direct teaching) approaches to mathematics instruction. Similarly, there is only a small body of literature regarding student attitudes towards mathematics, much of it focussed on gender issues rather than on the effects of different instructional practices or curricular approaches.

Philosophical Changes in Mathematical Education

In the philosophy statement that prefaces the British Columbia Ministry of Education's Mathematics Curriculum Guide (1988), mathematics is described as an integral part of human experience. The National Curriculum Council of England and Wales (DES, 1989) describes mathematics as a way of looking at, and
making sense of the world we live in. The National Research Council's (U.S.A) *Everybody Counts* (1989) describes mathematics as the invisible culture of our age, one in which "mathematisation" of society has increased the amount of mathematics students have to learn.

The change from the "industrial age" to the "information age" has led to a need for dramatic changes both in the mathematics programs offered in schools and in the methods used to present these programs (NCTM, 1989). The mastery of "shop keeper" arithmetic from Kindergarten through Grade 8, and pre-calculus mathematics in Grades 9 through 12 should no longer be seen as major goals for students (Romberg, 1989). Instead, students should learn to solve mathematical and non-mathematical problems, reason logically, communicate mathematical ideas and make connections between different strands of mathematics and with other disciplines (NCTM, 1989). Problem solving should include both routine mathematical problems in which the route to the solution and the mathematical skills to be employed are evident from the beginning and, perhaps more importantly, less conventional problems in which the students will have to analyse the situation, consider different strategies (B.C. Ministry of Education, 1988) and draw on a
variety of skills before a solution can be obtained. Problems should be of interest to the students and this can be achieved by giving problems related to the everyday world outside the classroom (B.C. Ministry of Education, 1992a) or, at least, related to the subculture of the classroom (Schoenfeld, 1989b).

The National Council of Supervisors of Mathematics (1988) describes twelve components of essential mathematics required by all students if they are to be able to compete successfully in the workplace. These are problem solving, communication, mathematical reasoning, applications of mathematics to everyday situations, alertness to the reasonableness of results, estimation skills, algebraic thinking, geometry, measurement, statistics and probability. All of these components can also be found in documents produced by the Ministry of Education in British Columbia, the National Council of Teachers of Mathematics in the United States, the National Curriculum Council of England and Wales, the Scottish Education Department, and the Curriculum Development Centre in Australia.

The changes in mathematics education, as outlined in the Curriculum/Assessment Framework Draft, (B.C. Ministry of Education, 1992a), which have taken place and are continuing to take place in British Columbia
are being paralleled in many other parts of the world. For instance the National Council of Teachers of Mathematics' *Curriculum and Evaluation Standards* (1989) document in the United States, the National Curriculum Council's (England) *Mathematics in the National Curriculum* (DES, 1989), and the Scottish Education Department's *National Guidelines* (1991) for mathematics curriculum all refer to the need for students to develop a conceptual understanding of mathematics, to become confident in their ability to do mathematics and to relate mathematics to other disciplines such as science, engineering, geography, art, and to the world outside the school and the classroom.

The mathematics curriculum has also expanded to include a broader range of topics. More emphasis is now being placed on geometry and data analysis while maintaining work on number operations and measurement. Calculators and computers are now an integral part of all work thus cutting down the amount of time spent on repetitive calculations.

Problem solving is seen as the focus of school mathematics in the 1990s, but many teachers and educators are not sure what is meant by problem solving. Does it mean the traditional problem solving in context and problem solving as a skill (Stanic & Kilpatrick, 1989) now often called routine problem
solving? Does it mean the solving of non-routine problems which require the student to ask questions, analyse information, discover patterns, and bring to bear all her/his mathematical and non-mathematical knowledge in order to find a solution (Bransford, Hasselbring, Barron, Kulewicz, Littlefield, & Goin, 1989)? Or does it mean a strategy for teaching in which the teacher poses problems which will lead to the development and understanding of new concepts? Current writing in mathematics education suggests that all of these approaches are required.

Stanic and Kilpatrick (1989) state that recent research shows that often children who have trouble solving problems in the mathematics classroom can solve comparable problems in a non-school situation. This would suggest that a mathematics camp could provide an opportunity for students to solve problems in a non-school environment and relate the mathematics used at camp to the mathematics learned in school and vice versa. The active involvement in solving realistic problems could also help students reinforce their knowledge and understanding of the mathematics taught in school (Steen, 1989).
**Instructional Methods in Mathematics**

The methods used to teach mathematics are just as important as the content of the syllabus being taught. According to Willoughby (1990), mathematics must be taught in such a way that students will not only be able to solve problems but will want to use mathematics and will think of mathematics as a friendly tool. Students have to be actively involved in solving problems, reasoning and communicating their ideas if they are going to develop "mathematical power" (B.C. Ministry of Education, 1992b). The Mathematical Association of America (1991) in the Preface to *A Call for Change* states:

students will develop 'mathematical power' only if they are actively involved in doing mathematics at every grade level. 'Mathematical power' denotes a person’s ability to explore, conjecture, and reason logically, as well as the ability to use a variety of mathematical methods effectively to solve problems (p xi).

Active involvement and real life mathematical situations seem to be key phrases in curriculum guides and in recommendations for teaching methods. Teaching, therefore, has to try to create in students a positive attitude to mathematics by providing tasks which engage the students’ interest and attention. It should also try to show that mathematics can be a source of intellectual excellence and fascination and that success can provide a sense of satisfaction (DES, 1989).
It is widely accepted that students cannot learn mathematics merely by listening and imitating (National Research Council, 1989). Rather than being passive observers of mathematics, students have to be involved in appropriate projects, purposeful activities related to their world outside the classroom (NCTM, 1989). Lave, Smith and Butler (1989), and Stanic and Kilpatrick (1989), suggest that if stronger connections can be made between mathematical experiences outside school and mathematical experiences in the classroom then mathematical learning in school may be strengthened.

The Standards Documents (NCTM, 1989) in the United States, the National Curriculum (DES, 1989) in England, the Scottish Curriculum (Scottish Education Department, 1991) and the Mathematics Curriculum and Teaching Program in Australia (Ministry of Education, 1987) all recommend the use of practical, exploratory, hands on mathematical activities both in and out of the classroom. Coupled with the suggested use of more hands on activities in the learning situation, are strong recommendations for the use of cooperative learning. Working in cooperative groups provides opportunities for students to discuss problems, express opinions, exchange ideas, and formulate different strategies for tackling and solving problems in a non-
threatening environment (Davidson, 1990). Cooperative learning also improves students' attitudes and self-esteem while promoting higher achievement than do competitive and individualistic efforts (Johnson & Johnson, 1989, 1990). If this is true then having the students work together in groups at a mathematics camp will not only provide a more friendly and relaxed environment but also may help to improve their attitudes to mathematics.

Allocation of students to groups can be done by random selection or by student preference. Many teachers, however, advocate heterogeneous groups based on mathematical performance. Most teachers seem to agree that homogeneous groups consisting of all slow learners or all high achievers does not work well for either of these groupings (Davidson, 1990). Webb (1991) states that homogeneous medium ability groups or groups with a moderate range of abilities (high and medium or medium and low abilities) seems to promote active participation of all group members. She also observes more interaction within groups when there are equal numbers of boys and girls in the groups.

Attitudes

Most people have a negative attitude to mathematics. One only has to ask any group of adults
what they think of mathematics and the majority will respond in a negative fashion. As Hyde (1989) states:

> Where mathematics is concerned we have a truly remarkable cultural heritage of phobias and anxieties, misconceptions and myths, stumbling blocks and brick walls. (p. 224)

One reason for this negativism could lie in adults' perceptions of mathematics, which have been transmitted to students. Borasi (1990) contends that students believe that mathematics consists of a predetermined set of rules and procedures which have existed forever and which are passed on from generation to generation by teachers. Students perceive success in mathematics to be achieved by appropriately recalling and applying the correct procedures to solve given routine problems, and academic success is measured by the scores received on tests and examinations. If students fail to learn any of the rules or procedures they have a break in their knowledge which leads to errors and an inability to obtain the answers to the problems. Their lack of understanding of the processes means they cannot approach the problem from a different direction so frustration and anxiety develop. If the situation occurs often enough students cannot help but develop a negative attitude which then leads to an avoidance of mathematics which leads to more negative feelings, and so on.
In a review of anxiety studies Hembree (1990) concluded that anxiety depresses performance, and that anxiety comprises a fear of all aspects of mathematics, not just tests and examinations. If, however, performance can be improved, mathematics anxiety is reduced. One of the most disturbing discoveries of Hembree's study was that the highest levels of mathematics anxiety occurred among students preparing to teach in elementary schools. Meece, Wigfield & Eccles (1990) found that anxiety was related to a person's perception of his or her mathematical ability rather than his or her actual ability.

Qualitative measurements of attitudes to mathematics are quite difficult to conduct as few valid scales are available. Fennema and Sherman (1986) have produced a series of Likert-type scales for measuring various attitudes related to mathematics learning. These mini-scales can be used individually or as a complete package. The scales include confidence in learning mathematics; father, mother and teacher scales measuring perceptions of attitudes towards one as a learner of mathematics; effective motivation in mathematics; attitudes towards success in mathematics; mathematics as a male domain; usefulness of mathematics; and mathematics anxiety scales.
Mathematics Camps

A review of the literature, including an ERIC search, yielded no information on mathematics camps. Other sources, however, revealed some relevant information. A newsletter from the Association of Teachers of Mathematics in England (1982) gave a brief description of mathematics camps which took place in the early 1980s. Further enquiries did not provide any additional information.

Diane Olix (1988) has run mathematics camps, in Ohio, USA, mainly for Grade 8 to 12 students, for the past twelve years. She also runs camps for teachers who plan to organise their own camps. The main focus of her camps is to provide opportunities for mathematics students to experience applications of mathematics skills and concepts in an outdoor environment. A secondary objective is to provide opportunities for student interaction and personal growth through working in group situations (personal communication, December 1991, January 1992).

Some teachers in Victoria, Australia, have done work on outdoor mathematics using the school yard as a base for their activities. Most of their work has been with students in Grades 8 through 10. (Ministry of Education, 1987).

Three weekend camps have been held in British
Columbia, in April 1990, February 1991 and April 1991. These camps were for gifted and talented Grade 9 and 10 students from all parts of the province. The focus of these camps was to provide in-service for teachers in the areas of cooperative planning and cooperative learning and to provide interesting problem solving activities in mathematics for the students (Chong, 1991; Johnson, 1990).

A weekend mathematics camp for mathematically "at risk" Grades 7 to 9 students from British Columbia was held in May 1992. In-service was provided for teachers on how best to provide good leadership when working on problem solving with groups of students and strategies for leading debriefing discussions after the activities were completed. Students worked in different teams and were provided with a selection of mathematical activities considered to be of interest to them. I was a member of the Leadership team who planned, organised and ran this camp.

**Summary**

In summary, there is a clear trend toward a new vision of mathematics education evident in many parts of the English-speaking world. This new paradigm of mathematics education has spawned many curriculum documents and calls for action. At the same time,
there is a growing concern about attitudes toward mathematics learning, especially among female students. At present, however, the literature reveals few successful approaches to the implementation of the new ideas at the school level. In particular, there is little evidence that mathematics educators, as yet, have carried out field trials of alternative ways to approach the teaching of their subject.
CHAPTER THREE

ORGANISATION AND METHODOLOGY

The study described in this thesis has two major components: the design and implementation of a mathematics camp and the measurement and assessment of the effect the camp had on the attitude to mathematics of a group of Grade 6 students. This chapter describes the process of designing and carrying out the camp and the development of questionnaires to determine the effect the camp had on the participants' attitudes to mathematics.

Objectives of the Camp

Prior to beginning the specific processes of organising the camp I established the following objectives.

* To provide students with enjoyable mathematical experiences in a non-classroom environment.
* To provide opportunities for students to explore mathematics in a non-classroom environment.
* To provide students with opportunities to understand mathematics as a way of thinking and as an aid to solving real world problems.
To provide students with opportunities to solve such problems in a non-competitive environment.

To provide opportunities for students to work cooperatively and to solve problems in cooperation with others.

To provide activities related to the everyday world and to the strands of the British Columbia Mathematics Curriculum for Grade 6.

To encourage students to share their thoughts, feelings and experiences both orally and in written form.

To improve students' self-esteem, confidence and motivation.

**Organisation and Planning**

Collingwood School, from which the students in this study were drawn, is an independent co-educational day school which opened in September, 1984. The school is situated in West Vancouver and draws most of its clientele from North and West Vancouver, although there are students who travel daily from Vancouver, Burnaby, Coquitlam, Richmond and even from as far away as Abbotsford. The majority of students come from homes in which both parents go out to work although there are a few rich families. There are also a small number of
bursary/scholarship students. The school has an enrolment of 630 students spread through Kindergarten to Grade 12. There are no entrance examinations for kindergarten and entrance examinations for other grade levels are used to assess the applicant's readiness to cope with the work of that grade. The curriculum at each grade level is that prescribed by the B. C. Ministry of Education with enrichment where appropriate. The school aims to provide a balanced education focusing on the strands of academic achievement, artistic growth, athletic development and community service.

The decision to proceed with the camp and related research was made in early November 1991. A provisional date of early May was set for the actual camp to allow adequate time to plan and prepare both the camp and the questionnaires.

Preparation for the camp can be roughly divided into two parts; planning, organising and administering the camp, and planning the activities to be undertaken at the camp.

The first step, taken in late October, 1991, was to obtain approval in principle from the school administration and to follow this with discussions with the Grades 4 through 7 teachers as to which grade level should be involved in attending the camp. I was
fortunate in that all the Grade 4 to 7 teachers were enthusiastic about the idea of the camp. Moreover a number of other teachers in Collingwood and from other schools expressed an interest in being involved in the camp in some way or another.

My decision to take Grade 6 rather than 7 was based on the fact that, at Grade 6, all three teachers were responsible for teaching mathematics while at Grade 7 one teacher taught all the mathematics. I also felt that Grade 6 could gain as much from the camp as could Grade 7.

In early January, as soon as the decision to take the Grade 6 students to camp had been made, planning of the actual camp, as opposed to the activities, started. This involved setting suitable dates which did not clash with other school activities and finding a suitable location for the camp. In fact finding a campsite proved to be difficult because all the conveniently located sites were fully booked from April 1 through to August 31. My original plan to hold the camp in early May had to be amended when the only time I could get a campsite was from 6th to 8th April, 1992, one week after our Spring Break.

The camp was held at Sasamat Outdoor Centre in Belcarra, about 25 kilometres from downtown Vancouver. The campsite is located in a wooded area on the shore
of Sasamat lake. There is a main lodge containing a large dining/meeting room, kitchen, washrooms and showers. Students sleep in comfortable cabins set among the trees not far from the lodge and there are another two cabins which can be used as classrooms. At the edge of the lake there is a dock with canoeing facilities and a picturesque trail round the lake. Maps of the location and the campsite can be found in Appendix A.

Having made a provisional booking, the next step was to calculate costs, apply for funding, arrange transportation, inform parents of the camp, organise permission slips, collect registration fees, prepare equipment list for the camp and for the students, and select and train Grade 11 student counsellors.

Counsellors

All students at Collingwood have to participate in the Project McKenzie program. This program, which is similar to the Duke of Edinburgh Awards Scheme, includes components of social responsibility, good citizenship, and the development of leadership skills.

Six Grade 11 students who had expressed interest in gaining experience as camp counsellors and improving their leadership skills were selected to assist at the camp. The original plan was to provide
them with sufficient training and guidance that they would have a clear understanding of their roles and responsibilities before leaving for camp. Due to the earlier than expected dates for the camp, and the fact that the counsellors were not selected until after Spring Break, there was not enough time to complete this task. Their teacher/supervisor did spend considerable time completing the task on the first evening of the camp. The training was to include a description of their roles as facilitators in cooperative working groups. This was to include initiating group discussion of the activities including strategies for tackling the problems, providing hints if the team seemed to be having difficulty at any point, promoting discussion and reflection after each activity and displaying a positive attitude towards the activities.

Other duties which they were to be responsible for included planning and running theatre sports, overseeing the preparation of skits, games, camp-fire sing-songs, wiener roasts and supervising the students at bedtime and wake up and walk in the morning.

On a more general level the counsellors were expected to serve as role models which would gain them the respect and friendship of the younger students thus forging stronger ties between the grade levels which,
it was hoped, would transfer back to the school environment.

Since the camp was to be a learning experience for the counsellors, they were asked to focus on their own personal development and growth. To help with this they were expected to keep personal journals throughout their involvement with the camp from which they were to write a report on what they learned and what contribution they made to the camp. They were also to be involved in discussions regarding all aspects of the camp both during and after the camp.

**Final Preparations**

Pressure of work and other commitments precluded the Grade 6 teachers from being involved in the early stages of planning, but as the time for the camp drew closer they became increasingly involved.

Since the camp was part of my research project, the students were not given any information regarding the activities of the camp. This made it more difficult for the teachers to "sell" the idea of a mathematics camp to the students. They did an excellent job, however, and all 53 Grade 6 students signed up to attend the camp. A few students did not sign up for the camp until the last moment. This was due to their lack of interest rather than any
reluctance on the part of their parents. In fact the majority of parents returned the signed consent form, which included their agreement for their child to be involved in the research and to pay the $65 for the camp, almost immediately. Most parents also paid the extra $10 for the camp T-shirt. The students who did not wish to attend the camp were informed that they would still have to attend school but were not given any information as to what they would do in school. In fact they would have been placed in either a Grade 5 or a Grade 7 class.

Part of the preliminary work which the three Grade 6 teachers undertook was to ensure the students knew how to take notes and keep a journal, to assign students to teams, to allocate students to cabins and to explain basic rules of behaviour. They also organised a competition to design a mathematics T-shirt for the camp. Students were asked to design a T-shirt based on doing mathematics at a camp. They were given some time in class but most of the work was done out of class time. More than 20 designs were received and displayed in the hallway before a decision was made as to the design to be used.

In addition to the normal planning for the camp, parents and students had to be informed that the camp was part of a research project, and permission to
take part in the study had to be obtained from the school, the teachers, the parents and the students (see Appendix A). Also, questionnaires for students and parents had to be designed and administered. These will be discussed in a later section.

**Camp Activities**

Planning and designing the activities and the program for the camp was an exciting experience. A number of people expressed strong interest in contributing to the mathematics side of the camp and they, by reason of work schedules and time constraints, divided themselves into two groups. Pat Barrett, Mathematics Helping Teacher for Surrey School District; Grace Fraser, formerly Mathematics Coordinator for the Ministry of Education; Stella Tossell, mathematics teacher and formerly Mathematics Consultant for Ginn and Company, publishers; and I met and discussed types of activities, timelines for activities, debriefing ideas and the general mathematics atmosphere of the camp. The wealth of experience and breadth of knowledge, gained over many years of involvement in mathematics education, which they brought to the meeting was invaluable. Pat was, in fact, the coordinator of the 1991 mathematics Camp for gifted Grade 9 and 10 students held in British Columbia and
Stella was a member of the planning team. Pat and Grace also read through the final draft of the camp activities and made valuable suggestions for modifications.

Margaret McDonough, Principal of Maimonides School in Vancouver; Margaret Jones and Patricia Ward from Crofton House School; and David Ward, Patricia's husband, helped with the design of the actual activities. In a brainstorming session held on January 23, they provided lists of ideas and I gave my list of ideas, all of which were used as a basis for more ideas and for designing a rough format for the camp. The format was based on:

1. Groups of activities which could be used as part of a camp or extracted and used in a "mathematics day" or "mathematics afternoon."

2. Activities which allowed teams to be spread throughout the camp to allow each team to have independence and autonomy.

3. Activities which involved the entire group or where large groups could be involved at the same time.

Elementary students tend to have lots of energy (Davidson, 1990; NCTM, 1989) and I assumed that, after sitting on a bus for over an hour getting to the camp, they would be more interested in action than sitting
listening to staff members going over rules and regulations. This led to the idea of providing each team, as soon as they had put their equipment in the cabins, with a blank map of the campsite and asking them to mark in all the significant features. This also served the purpose of including some mathematics and a focus for their natural tendency to explore the camp ground.

The final selection of activities for the camp was based mainly on my own experiences and observations as to which activities would be intrinsically interesting to Grade 6 students and whether or not each activity would provide a sufficient challenge to make it worthy of completion but not so difficult as to lead to frustration (Brophy & Alleman, 1991). In many of the activities the students were asked to estimate answers. The use of this phrase was to emphasise the fact that there were no single right answers to most of the questions and did not mean the students should not attempt to find their most accurate estimate. A copy of all the mathematical activities is included in Appendix B.

Activities had to be designed to provide opportunities for groups to work together for longer than the normal period of time allocated in the school setting. Since there were 13 teams of 4 students, and
each team needed enough space so that it could operate independently of the other teams, a variety of activities was required. In the end, each team was allocated two activities from a total of seven. These seven activities included: finding the perimeter and area of the swimming area, the area of skin required to cover one team member, the height of a tree a number of different ways, the number of logs required to fill the wood shed, the water flow in the stream, the area of the grassy play area and designing a covered walk way connecting all the cabins to the main lodge and calculating the amounts of material required to complete the task.

The camp included activities, both mathematical and non-mathematical, which involved the whole group, subgroups and individuals. The environment game, which was played by two large groups, involved drawing graphs and discussing the environmental issues which caused the fluctuations in the graph. The treasure hunt was carried out in teams but since everyone was involved in the same activity there was considerable interchange among the teams. Katherine Heinrich of the Department of Mathematics at Simon Fraser University gave me the instructions for making kaleidocycles which are like 3-dimensional hexaflexagons. Each student attempted to make at least one kaleidocycle. This was an individual
activity carried out at tables with a lot of social interaction and helping of one another. Teams also had to come up with a team name and a team badge early in the camp.

An essential ingredient of the camp was to provide opportunities for teams to make choices with regard to the activities they tackled. These options allowed teams to discuss a variety of tasks before making any commitments to the tasks, to have a sense of ownership and to take pride and satisfaction in successfully completing their chosen tasks. Three sets of activities were prepared, with each set containing five or six problems from which each team could select two, or possibly three. Set A included timing a run of 100 metres, finding the value of a trail of quarters, calculating a person's growth rate, enclosing the largest area with a rope and estimating a long distance. Set B included finding examples of 1,000,000, instructing a "blind" person, finding the perimeter and area of a leaf, measuring heart rate, estimating a very large area, and connecting all the buildings by telephone. Set C were designed to be completed indoors in case of rain or cold weather and to provide some restful activities. They included redesigning the cabins, playing mathematical games, cooperative problem solving, the eight queens chess
problem and finding the largest volume of a cone.

Each team activity required the team to carefully read each problem to ensure everyone understood the task. This was followed by a discussion of various strategies which could be used. At the end of the activity the teacher or student leader took time to debrief the team. This was considered to be an essential part of the activity in order to allow teams to reflect on the activity, discuss changes which could be made in their strategies, and talk about what they had learned.

The final mathematics activity of the camp was for each team, with its leader, to try to design an original problem which would be interesting, challenging and which could be used at a future camp. To help focus their thinking, teams were asked to reflect on all the activities they had attempted, focus on the ones they enjoyed the most, discuss what they enjoyed about these particular activities and what mathematics was involved and then to brainstorm ideas for their new and original problem. This change from doing problems to posing them was a true challenge of each team’s skills. My expectation was that, having spent two days working on real world practical problems, the students would design similar practical problems. The suggestion to reflect on the activities
they had spent the previous two days on was to encourage this process. These problems can be found in Appendix C.

The camp, of course, was not restricted only to mathematics. Included in the camp were discussions, note-taking for portfolios, environmental issues as well as the development of social skills, learning to live and work together, and the improvement of self-image and motivation as a result of solving problems in a non-competitive environment. Also included were non-mathematical activities such as theatre sports, skits, morning walks, soccer, campfires with sing songs, wiener roasts, marshmallow roasts and ghost stories, plus free time just to relax.

**Attitudes**

A major purpose of the study was to measure students' attitudes to mathematics before and after the camp to determine if there was any measurable change in attitude as a result of attending the camp. In order to do this, suitable procedures and appropriate measuring instruments needed to be developed.

If students see mathematics as a narrow and rather rigid set of facts and procedures which have to be memorised and applied in routine situations unrelated to the world outside the classroom then this
could be considered as a possible cause of negative attitudes (Buxton, 1981). Since the activities of the camp focused more on understanding the problems and the processes involved in tackling them rather than on speedy completion of the tasks within a short period of time, the camp could be seen as providing a positive learning environment. The relative lack of exact numerical answers which would be awarded marks or grades together with the complete absence of prizes or awards constituted a non-competitive environment where the students were expected to gain satisfaction from working through the problems.

One disadvantage of carrying out an original project is the lack of available, proven questionnaires. However, a variety of pre- and post-camp questionnaires were developed based on questions which had appeared in previous British Columbia Mathematics Assessments of Grade 4 and Grade 7 students (1990), ideas from a questionnaire used by Alan Schoenfeld (1989a) and my own personal experiences. I was also given considerable assistance by a colleague who has been involved in designing educational research for over twenty years, including work for the Educational Research Institute of British Columbia. Students' attitudes were measured both quantitatively and qualitatively using these tests, both before and after
the camp. This information was supplemented with personal observations by staff and student leaders and with interviews with staff and student leaders.

Parents were also asked to fill out questionnaires regarding their perceptions of their child's attitude to mathematics and whether or not they, as parents, contributed positively to their child's attitudes to mathematics. Two questionnaires were issued to the parents, one before the camp and the other about eight weeks after the camp. Students also filled out camp evaluation forms immediately after the camp. Copies of all questionnaires are included in Appendix D.

Four questionnaires, A, B, C, D were completed by the students during class time, one each day, during the week prior to the camp. To avoid bias in responding to the questionnaires the students were not given any information regarding the activities planned for the camp until the questionnaires had been completed. Questionnaire A consisted mainly of statements to which students were asked to respond using a five-point Likert scale. A few questions were open-ended and of the form, "The first thing which comes to mind when I think of mathematics is ...", which required only a brief response. The statements and questions were designed to obtain information
regarding the students' perceptions of the mathematics they study in school and the value and importance they place on mathematics both now and in the future. It was assumed that if students perceive mathematics to be a series of facts and procedures which have to be memorised, but which are of little interest or importance, then the learning of mathematics will be hindered and poor attitudes develop.

Students were asked to complete questionnaire A again shortly after the camp. This allowed for a comparison of responses to see if there were any differences which could be attributed to the camp.

Questionnaires B, C, D were experimental in design in an attempt to get a sense of the students' attitudes to, and understanding of, mathematics outside the classroom. A secondary consideration was to provide variety in the questionnaires in order to maintain student interest.

Questionnaire B was concerned with applications of mathematics. In Question 1 students were given a real life scenario and asked to list as many different applications of mathematics they might use if they were involved in the project. In Question 2 the students were given three different pictures and asked to list any mathematics suggested by each picture. A similar, but not identical, questionnaire was given to the
students shortly after the camp. This questionnaire was based on the notion that if students saw more applications of mathematics after the camp then mathematics would have become more relevant to them and, therefore, they would be more positive about studying mathematics.

Questionnaire C was concerned with making mathematical connections. Students were given a list of nineteen words or phrases together with a list of seven mathematical categories. The students were then asked to place words or phrases in the categories and state the connection which led them to making each placement. Words and phrases could be placed in more than one category and space was provided for students to "invent" their own category. Students completed a similar questionnaire shortly after the camp. It was felt that if, after the camp, students made more connections between the various words and phrases then it could be claimed that they are forging links with mathematics in the everyday world which makes mathematics more interesting.

Questionnaire D connected people with mathematics. Students were given the names and short descriptions of some well known people and then asked to describe ways in which these people might use mathematics in their daily lives. This questionnaire
was not repeated after the camp.

On the day the students completed questionnaire D I received a copy of Fennema and Sherman's *Mathematics Attitudes Scales* (1986), unfortunately too late to be used.

Additional information was collected by observation of the students at the camp, through informal discussions with staff and student counsellors both during and after the camp, and by reading the portfolios produced by the Grade 6 students after the camp.
CHAPTER FOUR

RESULTS

In this chapter the data collected concerning both the camp and the students' attitudes to mathematics is analysed both qualitatively and quantitatively. The information was gathered from a series of questionnaires completed by students and their parents, from student portfolios, and from discussions with teachers and student counsellors both during and after the camp.

Camp Evaluation

Modifications and changes were made throughout the duration of the camp to ensure that the students' experiences were as rewarding and enjoyable as possible. The observations of the staff and counsellors during the camp indicate it was a worthwhile and enjoyable learning experience for the students. The atmosphere throughout the two and a half days of the camp was very positive and many students commented on how much they enjoyed spending time with their friends and making new friends. Certainly, for many students the camp was a new and exciting adventure. Many of them remarked on how much they enjoyed being out in the wilds, singing songs and
telling ghost stories round the campfire then having to go to their cabins in the dark, and lying awake telling stories till late at night. Of course the log walk was popular, especially when someone fell in the water. The early morning walk, or run, round the lake was enjoyed by all but one student.

It was interesting to observe the development of the students' abilities to work together cooperatively, to solve problems in a more efficient manner and to discuss the processes after each activity. For instance, the debriefing after Activity 1, completing the map, highlighted the need for discussion and planning prior to tackling the problem. Most teams, in fact, completed the map satisfactorily but realised during the debriefing that they could have done the job more easily if they had planned in advance.

For the activities on the first afternoon the students quickly realised that, although the problems were not difficult, planning and teamwork were necessary in order to obtain a solution to each problem. Some interesting solutions were observed for finding the skin area of a student. One solution was to consider the body as a series of cylinders. Grade 6s do not know the formula for the surface area of a cylinder but this team intuitively understood the idea of opening out the cylinder to form a rectangle.
Another solution was to lay the body down, draw round it, calculate the area and double it. An improved version was to add on the "vertical" area of the sides.

The second day saw an improvement in performance, students were better able to discuss strategies and contributed more to the debriefing processes. Being able to select activities was an added incentive as it gave the teams more ownership of the problems. In Activities A the most popular activity was the 100 metres run. In fact this was the most popular activity overall. Many students were surprised by their inability to estimate 100 metres. Most teams underestimated by 30%. Various reactions were noted when the students stood at the point they would reach when Carl Lewis was crossing the finishing line. Comments varied from amazement that they would be so far behind, to pleasure that they could do so well against the champion.

The most popular activity in Activities B was the blind walk, a problem which proved to be more challenging than the students expected. All the teams had to re-evaluate their solution when they realised the "blind" person took shorter more tentative steps. Most teams also took the shortest route but ran into difficulties when the "blind" person tripped over rocks, walked into bushes etc. Only one team started
off with a longer but easier route.

Activities C provided some rest and relaxation. The support structure problem and the 8 queens chess problem provided a challenge and Connect 4 was very popular.

The commitment to, and the interest in, the problems, especially on the second day, clearly demonstrated that the decision not to award points or prizes to teams or individuals was the correct one. The satisfaction gained from successfully solving a problem was reward enough.

**Formative Evaluation and Consequent Modifications**

It did not take long to realise that there were too many mathematics activities scheduled for the camp. This was not, however, considered to be a problem as it was easier to remove or modify activities than try to create worthwhile problems at a moment’s notice. The main difficulty was caused by underestimating the time required to complete each activity satisfactorily, together with a failure to build in time for debriefing at the end of each activity. I had included the need for students to discuss and reflect on each problem upon completion, but had failed to build in the necessary time for this important aspect of the program.
Activity 2, tying a tape to a tree, was removed from the first morning and the building of straw towers from the afternoon. On Tuesday morning students were assigned to one set of activities from sets A, B, C and to the other two in the afternoon. In fact they should only have been assigned to one of these in the afternoon in order to decrease the time spent on mathematics and allow some free time. I decided, however, that many students, having talked with their friends, were looking forward to some of the activities in their third set. This, I think, is when some of the students began to go on "mathematics overload".

The mathematics Treasure Hunt was moved to after supper and the games league competitions cancelled. Within the major activities the clinometer measurement and Pick's method were removed, as was the rainfall measurement.

The darkness activity from the first night was cancelled and on the second day, in Activities B (See Appendix B), the measurement of body temperature was removed. In Activities C (See Appendix B), the budget exercise was eliminated and the games activity was modified to allow the students to relax and play the games purely for pleasure.

The final activity for the third morning was not planned prior to the camp. Since the camp was
experimental in nature it was felt that the final activity should try to bring together as many aspects of the camp as possible and be a form of celebration of the positive (mathematical) experiences of the camp. Thus it was decided to ask each team to reflect on their mathematical experiences and then to design a unique problem which could be used at a future camp. Despite the obvious tiredness of the students, this proved to be an interesting exercise. Some of the problems, in fact, turned out to be paper and pencil exercises which could equally well be completed in the classroom rather than the out-doors. The problems are contained in Appendix C.

**Students' Evaluation of the Camp**

Students filled out camp evaluation forms on the afternoon they arrived back at school and the results are contained in Appendix D.

In question 1, only 20 percent of students claimed to have enjoyed the mathematical activities yet, on reading the portfolios, the responses to the activities were positive with a majority of the students stating they enjoyed most of the activities they attempted. Since 98 percent agreed in question 2, there can be little doubt the non-mathematical activities were successful. The responses in question
3 indicate that 60 percent enjoyed working cooperatively while almost 30 percent did not know. In question 4, approximately 40 percent learned a lot of mathematics while a similar number, in question 5, learned a lot about mathematics at the camp. In question 6, almost 60 percent felt their understanding of mathematics improved as a result of the post-activity discussions. Only 30 percent claimed to have had a wonderful time at camp, a response which is a little at odds with the enthusiasm observed at the camp.

By far the most popular activities were the 100 metre run, the writing of instructions for a blind person and the styrofoam cup balance. Probably the least popular activity was the Treasure Hunt, perhaps because the instructions were not clear enough.

In the responses to question 9 asking the students if they would like to attend camp again next year 37 percent said "Yes" and more than half of these said it was because they enjoyed the mathematics activities. Of the 31 percent who said "Maybe" some qualified their response by suggesting there was too much mathematics at this camp. Thirty-seven percent said "No" to camp next year; this included 10 percent who objected to too much mathematics and 15 percent who are against any form of mathematics. One person said
"No" because there was not enough mathematics.

In response to "What did you like best at the camp?", 40 percent were for free time and 19 percent said the camp fire. This is understandable as any camp of this nature is a big event for most grade 6 students; being away from home, sharing cabins, talking all night, telling ghost stories round the camp fire etc. are all valuable experiences for children. A small number (6%) of the responses said some of the mathematics activities were best.

In response to suggestions for changes 43 percent of the responses were for less mathematics and more free time. The rest of the responses covered a wide range of ideas including mixing the camp with activities like canoeing, staying longer and two requests for more mathematics.

**Attitudinal Scales**

One part of this research project was to measure the students' attitudes to mathematics before and after the camp to see if there was any observable change in their attitudes.

Although there was no statistical evidence to show that students' attitudes improved as a result of the camp some encouraging trends were noted.
Those questions from pre- and post-questionnaires A which had five point Likert-type responses were analysed using statistical techniques. Pre- and post-test results were compared for each item by means of t-tests. The results showed no statistically significant differences on any items, indicating no measurable change in attitude to mathematics of the students as a result of attending the camp. The responses in each category for each item in the pre- and post-questionnaires together with those from the sub-set of items given eight weeks after the camp are listed in Appendix D. The eight questions used for the final questionnaire were those from the original questionnaire A which were considered to be most likely to be influenced by the camp. An investigation of the mean responses to each of these eight items showed no consistent pattern. For six of the items the means fluctuated from pre- to post- to final. Only on two items did the means show a swing in one direction and in both cases the trend was positive but very small.

In response to Question 18, "The thing I like best about maths is ...", the pre- responses were fairly evenly spread among Number Operations (18%), Geometry (16%), Problem solving (11%), Success (on
tests etc.) (16%), Usefulness (20%), and Enjoyment (13%). In the post- responses Problem solving jumped to 29%, which is a positive sign, and Success increased to 24%, while the other categories decreased.

In response to Question 19, "The thing I like least about maths is ...", the pre- responses were Failing (tests etc.) (28%), Number Operations (20%), Problem solving (15%), Paper and pencil work (13%), and Memorising rules (10%). 8% claimed they disliked all mathematics. No significant pattern was noted in the post- responses with Number Operations and Geometry increasing while the other categories decreased.

In response to Question 20, "The thing that makes me feel good in maths ..." the pre- responses were Success (in tests etc) (73%), Usefulness (10%), and Enjoyment (10%). In the post- responses the figures dropped slightly, possibly due to an increase in the number of students who did not respond to this question.

In response to Question 21, "The thing that makes me feel bad in maths ..." the pre- responses were Failure (in tests etc.) (61%), Problem solving (9%), and Everything (14%). 2% said they liked all mathematics. The only change in the post- responses was an increase to 16% for those who liked all mathematics, a positive sign.
In response to Question 22, "The scariest thing about maths ..." 60% claimed lack of success (in tests etc.), 10% cited specific topics, and 14% said nothing was scary. The post- responses were similar.

In Question 23 students were asked about their likes and dislikes of specific topics and in Question 24 they were asked to rate the importance, or otherwise, of these same topics. There was an improvement in the popularity of Data Analysis, although only the Deer Game involved statistics. There was a slight decrease in both the popularity and the perceived importance of calculators and computers. This could be due to calculators being considered purely as tools which save time and effort.

In response to question 25, "The first word(s) which come to mind are ..", 60% listed specific topics, 13% listed words such as important or challenging, 11% listed words like fun or enjoyment, and 17% gave negative words. In the post- responses 50% listed specific topics, 19% listed important or challenging, 6% said fun or enjoyment, 6% said tests and 13% were negative.

In a number of questions the swing in responses from pre- to post- results was to the "Don't Know" or "neither like nor dislike" categories. This could be explained by the fact that students were "mathed out"
as a result of the camp and selected the easiest response to some of the questions.

Questionnaires B

These questionnaires were similar but not identical. This was to avoid the possibility that students might remember their responses to the first version when answering the second.

In Question 1 of Questionnaire B (Appendix D), responses included estimates of volumes, weights, and quantities of supplies; numbers of planes available, their speeds, length of times of flights, numbers of support people, and the various related costs. Two students mentioned angles and measurements related to flight routes, and one student mentioned the Richter Scale.

In Question 2a of post-Questionnaire B, which was a picture of a bicycle, responses ranged from diameter, radius, circumference and speed of rotation of the wheels, to distance, speed, time, to costs, gears and aerodynamics.

In my first attempt at analysing the information I classified the responses under fairly general headings. For example in Question 1, I used distance, speed, time, quantities, costs, etc; in Question 2, I used headings of patterns, perimeter, geometrical
shapes, etc. The percentage of responses in each category was calculated and the changes from pre- to post- questionnaires investigated qualitatively. I concluded that the changes, both positive and negative, were, in fact, more likely to be due to the differences in the questions rather than to the effects of the camp. As a result I reclassified the results into "routine" and "non-routine" responses. Routine responses were those I considered to be obvious or very general (e.g., speed, pattern, shapes). Non-routine responses were more specific (e.g., triangles, how much fuel the plane used) or unexpected (e.g., Richter scale, length of skis). The percentage of responses was calculated for each question and pre- and post-results compared. I assumed that the non-routine responses would give an estimate of a broader interest in mathematics.

In Question 1 the non-routine responses dropped from 37% of the total responses to 26% of the total responses. In Question 2a, pre- and post- percentages were the same while in Questions 2b and 2c there was an increase in non-routine responses of over 10% from pre- to post- questionnaires.

A closer look at the questions suggests that Question 1 in the pre-questionnaire offered more opportunities for a variety of responses. This is
reflected in the fact that there were approximately 14% more responses to the first questionnaire. I would like to claim that the 11% increase in non-routine responses in Question 2c was due to the effect of the camp but it could also be true that Grade 6 students are more familiar with bikes than with cars. The increase of 15% in the non-routine responses to Question 2b suggests a positive trend. It should, however, be noted that the pattern in the post-question is slightly larger and it is, perhaps, easier to see different shapes and symmetries.

As a footnote, it is interesting that if all the responses are totalled the non-routine responses represent 21% of the total responses on both pre- and post- questionnaires.

**Questionnaires C**

The responses were tabulated and the average number of responses in each category calculated for both pre- and post- questionnaires. These results are contained in Appendix D. The average number of responses did not show a trend in either direction; in circles and patterns there was a slight increase in the numbers of circles and patterns recorded while in polygons, rate, numbers and flips, slides and turns there was a decrease in the numbers of responses in
these categories. A closer look at the pre- and post-word lists suggested there were probably fewer examples of polygons or numbers in the second list. The second grouping, solids, was considered to be invalid as many of the students listed everything that was solid while others attempted to list only geometrical solids. Over 80% of the students did not create their own category or used an already defined category. The few students who did create a category listed items such as food, sport or camping.

**Questionnaire D**

Bryan Adams received about 50 percent more responses than any of the others, probably because his name is more familiar to the students than are Roberta Bondar, Grant Connell or Mike Harcourt. In the last category, "your mother, step-mother or female guardian", I excluded the mathematics related to mothers' jobs in order to keep the sample uniform.

For Bryan Adams, almost half the responses were to do with money - income, expenses, and profits. Other responses related to travel and a few mentioned the mathematics of beats and rhythms. Two interesting responses were for the amount of clothes required in order that he could wear different combinations without repetition and the other was the mathematics of
creating flashing lights and laser effects.

The majority of responses for Roberta Bondar were for mathematics related to her experiments and the mathematics of speed, orbits and time in space. Two students mentioned pulse rate and how much she grew and one student mentioned the countdown while another remarked on the number of interviews given on the return from space.

Responses to Grant Connell were money related, the number of games or tournaments or distances and times of travel. Mention was made of the speed of his serve and the angles of his shots.

As with Adams and Connell, Mike Harcourt was seen to be involved with money - raising taxes, spending and balancing the budget. Smaller numbers mentioned counting votes and problem solving and planning connected with roads, hospitals, and logging.

Half of mothers' mathematics was related to spending, shopping, and balancing the budget. Measuring quantities for cooking and baking came second and small numbers of students mentioned days of pregnancy and answering mathematics questions from their child's homework.

Questionnaire D was not repeated after the camp as I felt, in the light of the responses to questionnaires B and C, that little additional
Parent Questionnaires

Only five parents failed to respond to the pre-camp questionnaire. This was, in part, because three or four students did not sign up for the camp until the last moment. The results of this questionnaire are given in Appendix D. The overall response to each question was excellent, indicating that the home environment of the students is positive and encourages the study and learning of mathematics.

Parent Questionnaire B was sent home to the parents eight weeks after the camp and 33 of a possible 52 responses were received. The questions focused on the parents' perceptions of the effects of the camp on their child. Overall, the results (see Appendix D) were very encouraging. Almost 80 percent said the camp was a valuable experience while 50 percent said that, as a result of the camp, their child has a better attitude to mathematics. Almost 70 percent said their child spoke positively about the mathematics activities of the camp.

One comment which a parent added to the pre-camp questionnaire was, "We feel the Mathematics Camp is an excellent way to present maths in a non-academic
environment", and, since the camp, a number of parents have made similar verbal comments to myself and to the other teachers.
DISCUSSION

When they said Math Camp,
I said no,
Maybe...I didn't want to go,
But they said, "Come along and see,
How much fun learning Math can be".

So off I went,
And I found out
Just what Math Camp was all about.

It was fun and friends,
And nighttime noise,
Learning to cooperate - with boys!
Problem solving,
Thinking things through
Lots of things for us to do.

Math Camp is for me!

Lynnlea Longworth

The poem was written by one of the Grade 6 students who has always had difficulty with mathematics. She did not want to go to camp because she did not think she could possibly enjoy herself. Now she feels that, despite her difficulties, mathematics is much more interesting and can even be fun. Another student, labelled as a nuisance in school, enjoyed the more active approach to mathematics so much he, unconsciously, took on a leadership role for the duration of the camp. So for two students, at least, the experience of camp changed their perceptions of mathematics.
When one considers the fact that we tried to do too much mathematics during the short duration of the camp it is not surprising that some students were suffering from "mathematics overload" after the camp. This may, or may not, have influenced their responses to the post-camp questionnaires. Certainly the information gathered from the student questionnaires indicated that there was no significant change in the students' attitudes to mathematics immediately after the camp or eight weeks later. These results seem to be slightly at odds with the effectiveness of the camp as witnessed by myself and the other staff and student counsellors. It is, of course, possible that the questionnaires were not entirely valid. The absence of any similar studies from which attitude questionnaires could be compared made the construction of suitable measuring instruments more difficult and, because of their uniqueness, made them suspect. It was unfortunate that I did not obtain a copy of Fennema and Sherman’s Mathematics Attitudes Scales, (1986), until after the pre-camp questionnaires had been completed. These scales could, at least, have been used as references during the construction of questionnaire A.

One possible reason for the absence of change in students' attitudes was that the mathematics activities, and the camp itself, were so different from
their classroom experiences that they did not relate camp mathematics to school mathematics. The camp may have been seen as an isolated single experience divorced from the normal classroom learning, and students at this age lack the maturity to incorporate the experiences of camp into the experiences of school. We also have to accept that, rightly or wrongly, some students do not like school in any shape or form.

Although there was no measurable change in student attitudes, the Grade 11 counsellors and the staff all considered the camp to be a worthwhile, enjoyable experience for the students involved. My observations coupled with the observations and comments of the other leaders also indicated that the majority of students enjoyed many of the mathematical activities. These findings were confirmed by the parents’ responses on their post-camp questionnaires.

Some of the positive aspects mentioned by the students were: discussing the problems, sharing ideas and strategies and working together towards a common solution to each problem. They certainly enjoyed the non-mathematical activities of the camp such as learning to live together and getting to know one another better. These are, of course, important and valuable aspects of any camp.
An additional bonus was provided by a group of parents. The time frame of the camp was such that we had to vacate the site before lunch time so a group of parents prepared a "mathematics lunch" for our arrival back at school. I did not see the original display but I gather there were Jello cubes with numbers piped in cream, sandwiches and cakes cut in geometrical shapes and the glasses and bottles of juice were graduated in 1/4's, 1/2's and 3/4's. Unfortunately the students were too excited to appreciate the mathematics involved; they "inhaled" the food and disappeared to find their friends from other grades.

The student counsellors' reactions were especially informative. During informal discussions round the camp-fire when everyone else was asleep, they talked enthusiastically about the camp in general and the mathematics activities in particular; they found them to be interesting and challenging. They also felt the camp should be extended to five days to allow time for all the activities and still allow time for journal writing, games, whole group activities and just "hanging out". It did not seem to occur to them to eliminate any of the mathematics problems. Another of their reasons for extending the camp was they found the first day less productive because the students did not know how to function in cooperative groups or to focus...
on the assignments, whereas on the second day most of the teams bonded well together, and became more involved in the activities. The counsellors felt that another day or two might have shown more exciting developments in the way some teams approached the problems. They also admitted they were more comfortable with their roles on the second day.

One valuable experience for the counsellors was learning the hard way that if any activity is going to be successful it has to be thoroughly prepared in advance. They admitted they thought they could run theatre sports and sing-songs from their own past experiences at camps. They were the first to admit that, due to lack of preparation, the theatre sports was a flop and the campfire sing-song was almost a flop. They were also able to compare these two activities with their telling of ghost stories, which proved to be a great success because they had prepared them in advance.

A bonus after the camp was the way one of the counsellors, who was in my Grade 11 mathematics class, displayed much greater motivation and self-discipline for the remainder of the year. Prior to the camp he had been making about a 70 percent effort whereas after the camp he was on task 100 percent of the time, with a corresponding improvement in his performance.
One of the immediate effects of the camp can be seen in the weekend Mathematics Camp for mathematically at risk Grade 7 to 9 students held in British Columbia in May 1992. This camp was to be based on the previous camps held for gifted Grade 9 and 10 students but, in fact, the mathematical activities used on the Friday afternoon, the Treasure Hunt on the Friday night, the Environment Game on the Saturday night together with all the activities on Sunday morning were based on activities from this project. Only the activities on Saturday afternoon were drawn from the Grade 9/10 camps. In addition the original camp evaluation form was replaced with the one used in my Grade 6 camp.

I have also received requests for information regarding the planning, organising and running of mathematics camps from California, Virginia, Michigan, Prince Edward Island and the interior of British Columbia.

**Changes in the Camp**

There was unanimous agreement among the staff and counsellors that we tried to do too much mathematics. This could be rectified fairly easily by scheduling only one set of the activities A, B and C in a morning or afternoon and allowing two hours for completion of each set rather than one and a half hours. The
remainder of each morning or afternoon could be taken up with journal writing, participating in whole group games, skit preparation or just "hanging out". These were aspects of the camp for which insufficient time had been allocated.

The alternative to cutting out some of the activities would be to extend the camp and incorporate other non-mathematical activities such as kayaking, canoeing, climbing and hiking. It might be interesting to consider the possibility of including some art, music or drama as an alternative to, or as well as, the outdoor activities.

Many of the activities of the camp would be entirely suitable for use at a Grade 10 camp and it would be interesting to see how older students tackled these same problems. A camp for Grade 10 students would also provide an opportunity to demonstrate to them the importance and value of mathematics before they enter the graduation program.

If a mathematics camp is going to be incorporated into the school year then teachers should be involved in the discussion, planning and organisation from the very beginning. Thus such things as keeping logs and writing portfolios could be incorporated into mathematics and other lessons, cooperative work and team building could be integrated as part of the daily
routine and each teacher could take responsibility for some aspect or aspects of the camp. This would not only share the work load but would give the teachers more involvement and ownership of the camp.

The Grade 11 counsellors proved to be a great asset to the whole camp experience. It would, however, be interesting to consider the possibility of having parents as camp counsellors. They would, in my opinion, require to be given a considerable amount of pre-camp training in leadership skills, understanding what is meant by cooperative learning, facilitating discussion in problem solving, and generally how to handle larger groups of energetic Grade 6 students. This could prove to be a valuable experience for the parents and is in agreement with the ideas of the Co-Production of Learning Project at Simon Fraser University and the EQUALS Family Math (Stenmark, Thompson, & Cosey, 1986) program in the United States.

**Implications**

This study could have implications in three areas of mathematics education: curriculum development, professional growth and training of teachers, and for future research.

In terms of curriculum development one conclusion that can be drawn from this study is that it is not
necessary to take the students to camp, instead, the camp can be taken to the students. Most of what was attempted at the camp could be included as an additional teaching strategy within the school setting. Many of the activities could be carried out in the school yard or in the classroom, and the ideas of working in teams, discussing strategies, working cooperatively and debriefing could all be used on a regular basis in the classroom. Questionnaires B, C, D, in fact, contain some particularly interesting ideas for projects.

Performance can be evaluated in the classroom by observation and discussion. As was demonstrated clearly at the camp, it is not necessary to use the implied threat of tests to motivate the students nor is a written test the only way to evaluate students' knowledge and understanding.

Everyone involved in curriculum development and curriculum implementation should be able to relate some of the above ideas to current educational philosophy.

Not only did the camp provide interesting activities for the students, it also proved to be a very valuable learning experience for all the staff involved and I believe the teaching of mathematics could be improved significantly if mathematics camps were held for teachers rather than students. Not only
would the teachers gain experience in organising and running a camp they would be exposed to a different approach to mathematics and mathematics education which could be incorporated into the regular classroom environment. The camp would require modification to incorporate instruction in problem solving, critical thinking and various aspects of cooperative learning. The benefits in improved teaching and learning would make this a worthwhile professional development project.

In terms of further research it would be interesting to develop a one-term or one-year pilot project incorporating cooperative learning, working together, sharing ideas and strategies, reflecting on the solutions to problems as well as many of the activities from the camp into regular teaching.

A pilot project of this kind could also investigate the integration of problems from other disciplines. This could include such topics as mathematics and mapping from geography or data recording and data analysis from science or social studies.

FRAMEWORK

Perhaps one of the most valuable results of this project has been the development of a planning
framework that can be used by other mathematics educators to develop and present similar camps for either students or teachers in their schools and districts. Although the camp itself lasted only two and a half days, several months of preparation were required. Sufficient time must be allowed for the planning process in order to secure suitable facilities, to develop appropriate materials and activities, to train teachers and counsellors, and to secure all necessary funding and administrative approvals.

It should be noted that the time lines given in the framework presented in tabular form below are based on the original plans to have the camp take place in early May.
<table>
<thead>
<tr>
<th>Date</th>
<th>Action</th>
<th>Personnel</th>
<th>Comment/questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early Sept</td>
<td>Preliminary meeting to discuss feasibility of, and interest in, a mathematics camp. Establish broad educational goals.</td>
<td>All interested persons.</td>
<td>Should the focus be on maths only or on maths plus outdoor activities, science, etc.</td>
</tr>
<tr>
<td>Mid-Sept</td>
<td>Approval in principle from Administration</td>
<td>Leader (L)+ Administration</td>
<td></td>
</tr>
<tr>
<td>End of Sept</td>
<td>Discussion - Provisional dates - Which students involved</td>
<td>All staff + Administration</td>
<td>Who should take part: whole grade or one class? Specific ability group?</td>
</tr>
<tr>
<td>Early October</td>
<td>Broad planning 1. Objectives of camp</td>
<td>Anyone who is interested or can contribute ideas</td>
<td>Teachers only? Teachers + High School Counsellors (HSC)? Teachers + parents? Teachers + HSC + parents?</td>
</tr>
<tr>
<td></td>
<td>2. Staffing for camp</td>
<td></td>
<td>Standard of accommodation Locale - water, woods, trails, hills etc</td>
</tr>
<tr>
<td></td>
<td>3. Staff commitment • from the start • only for camp • reference</td>
<td></td>
<td>Much easier if one person is contact person for campsite</td>
</tr>
<tr>
<td></td>
<td>4. Facilities required</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. Allocation of responsibilities • Campsite + related communications • Organisation, non-maths • Maths activities</td>
<td>One person (P)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6. Processes to be used • team building • cooperative teams • discussion/reflection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>Individuals think about maths activities for camp. List all ideas for later meeting.</td>
<td>All staff + anyone interested or knowledgeable</td>
<td>Allows 3-4 weeks thinking time.</td>
</tr>
<tr>
<td>---</td>
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<td>---</td>
<td>---</td>
</tr>
<tr>
<td>October</td>
<td>Locate possible campsites and availability</td>
<td>P</td>
<td>This may take 3/4 weeks</td>
</tr>
<tr>
<td>Early November</td>
<td>Meeting to brainstorm ideas for camp. Discuss draft format. Allocation of responsibilities • selection/design/scheduling of maths activities.</td>
<td>All staff</td>
<td>Time on maths? Time on non-maths? Variety of activities? Prizes/no prizes?</td>
</tr>
<tr>
<td>Early November</td>
<td></td>
<td>Group M</td>
<td>Teams, whole group, individual? Relate to NCTM Standards and B.C. framework, curriculum?</td>
</tr>
<tr>
<td>Early November</td>
<td></td>
<td>Group N</td>
<td>Games, skits, campfire, sing-song, morning walk etc.?</td>
</tr>
<tr>
<td>Late October</td>
<td>Finalise campsite location and dates</td>
<td>L + Administration</td>
<td></td>
</tr>
<tr>
<td>Late October</td>
<td>Funding</td>
<td>L + Administration</td>
<td>Subsidised by school? Sponsorship? Full cost borne by students?</td>
</tr>
<tr>
<td>Nov/Dec</td>
<td>Meetings as required</td>
<td>Groups M, N</td>
<td>Consider alternatives in case of rain</td>
</tr>
<tr>
<td>December</td>
<td>Pay deposit for camp</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>Book transport to/from camp</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Early February</td>
<td>Meeting to plan camp program • Grouping of activities • Scheduling maths/non-maths activities • Evening activities • Wake-up/lights out • Opening/closing activities</td>
<td>All staff</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
<td>Staff Required</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>--------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Mid February</td>
<td>Visit campsite</td>
<td>As many camp staff as possible</td>
<td>Excellent opportunity to compare program with the facilities and make modifications/changes to suit the location</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid February</td>
<td>Begin training counsellors (and teachers)</td>
<td>L + other &quot;specialists&quot;</td>
<td>Probably once per week for 5/6 weeks including, if possible, meeting or working with the elementary students.</td>
</tr>
<tr>
<td></td>
<td>• Initiating discussion before activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Encouraging action during activity</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Leading debriefing after activity</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>• Role modelling</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Specific responsibilities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Late February</td>
<td>Discussion of details of camp</td>
<td>All camp staff and counsellors</td>
<td>Walkmans etc (Y/N)? Food for snacks (Y/N)? Common elements to be taught prior to camp e.g. writing portfolios, etc.</td>
</tr>
<tr>
<td></td>
<td>• Behavioral expectations</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Preparation of instruction sheets for individual activities (allocate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Activity equipment lists (allocate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Plan camp reunion</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Early March</td>
<td>Announce camp to students</td>
<td>Classroom teachers</td>
<td>Possible sample activity to give them an idea of what to expect but don't give too much detail.</td>
</tr>
<tr>
<td>Early March</td>
<td>Inform parents, giving background, goals and objectives, approximate cost, location.</td>
<td>L</td>
<td></td>
</tr>
<tr>
<td>Mid March</td>
<td>Student competition to design T-shirt for camp</td>
<td>Classroom teachers</td>
<td>Allow 2/3 weeks to design, display and vote on the best design.</td>
</tr>
<tr>
<td>Early April</td>
<td>Letter to parents</td>
<td>L</td>
<td>Include location and details of campsite</td>
</tr>
<tr>
<td></td>
<td>• Permission for child to attend camp</td>
<td></td>
<td>Emergency phone number of camp</td>
</tr>
<tr>
<td></td>
<td>• Agreement to pay camp fees</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Medical, dietary information</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Emergency phone number</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Buy/not buy camp T-shirt</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid April</td>
<td>Collect money for camp and T-shirt (optional)</td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>Mid April</td>
<td>Information to local media</td>
<td></td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>Team building activities</td>
<td>Classroom teachers</td>
<td>Integrate into class work</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Mid April</td>
<td>Meeting - Go over final program in detail to ensure everything is clear, worksheets are</td>
<td>All staff +</td>
<td></td>
</tr>
<tr>
<td></td>
<td>understandable and all activities thoroughly prepared. Allocate various responsibilities</td>
<td>counsellors</td>
<td></td>
</tr>
<tr>
<td></td>
<td>related to camp.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid April</td>
<td>Equipment lists to students</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• personal equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• team equipment (pens, calculator, ruler etc)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mid April</td>
<td>Design camp evaluation form</td>
<td>L + help</td>
<td></td>
</tr>
<tr>
<td>Mid April</td>
<td>Assign camp recorder - video, slides, etc.</td>
<td>1 person</td>
<td></td>
</tr>
<tr>
<td>Mid April</td>
<td>Allocate students to sleeping quarters. Allocate students to teams.</td>
<td>Classroom teachers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Student teams design a team logo and invent a team name</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Behavioral expectations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>End of</td>
<td>Gather all equipment, worksheets etc in one place</td>
<td>L ?</td>
<td>Checklist to ensure</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td></td>
<td>everything returns</td>
</tr>
<tr>
<td>End of</td>
<td>Allocate specific areas of responsibility and duties at camp</td>
<td>All staff +</td>
<td>Supervising meals</td>
</tr>
<tr>
<td>April</td>
<td></td>
<td>counsellors</td>
<td>Lights out/wake up</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Morning exercise</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Distribution/collection</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>of equipment</td>
</tr>
</tbody>
</table>

**CAMP**

<table>
<thead>
<tr>
<th>Maths activities</th>
<th>All staff + counsellors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-maths activities</td>
<td>Some staff/ counsellors</td>
</tr>
<tr>
<td>Evenings (late) - meetings to review the day, plan for next day</td>
<td>All staff + counsellors</td>
</tr>
<tr>
<td>After Camp</td>
<td></td>
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<tr>
<td>---</td>
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</tr>
<tr>
<td>ASAP</td>
<td>Camp evaluation forms</td>
</tr>
<tr>
<td></td>
<td>Finish portfolios</td>
</tr>
<tr>
<td>First week</td>
<td>Meeting to discuss evaluation forms. General debriefing of camp</td>
</tr>
<tr>
<td>Mid May</td>
<td>Camp reunion with students and parents</td>
</tr>
<tr>
<td>End of May</td>
<td>Submit report to administration</td>
</tr>
<tr>
<td>End of May</td>
<td>Information to local media</td>
</tr>
<tr>
<td>Early June</td>
<td>Meeting to discuss effects camp might have on classroom teaching strategies.</td>
</tr>
</tbody>
</table>
Conclusion

Perhaps the idea that students' attitudes could be changed in the short span of two and one-half days was unrealistic. The contrast between the camp and the classroom was just too great and the environments so different that any transfer of ideas or attitudes from camp to school was, probably, unlikely.

What the camp did do was provide an opportunity for students to experience mathematics outside the classroom, to explore different approaches to solving problems and to realise that the final answer is not necessarily the most important part of a problem. The camp also provided opportunities for students to work cooperatively on interesting problems and to have fun doing mathematics.

If the camp is seen as a starting point from which change and growth can take place then it has been a worthwhile exercise.
APPENDIX A

COMMUNICATIONS AND MAPS

Communication with Mr. Baldwin .................... 85

Letter to Ethics Committee from Mr. Baldwin .... 87

Letter to parents - Camp information ............. 88
  - Research agreement

Map of camp location ............................... 90

Map of campsite .................................... 91
To: Graham

From: Jim M

Mathematics Camp for Grade 6 Students

Rationale.

If we, the school, can expose students to mathematical activities outside the classroom, then we will have provided opportunities for the students to apply their knowledge and skills to new and interesting situations which are not available in the normal classroom. The outdoor environment also makes it possible to provide the students with practical tasks more closely related to their every-day experiences, to give them opportunities to work with students from the other classes, and to interact with teachers in a more relaxed and informal atmosphere.

Provided the activities are intrinsically interesting and within the capabilities of the students, the students should develop an understanding and appreciation of mathematics as a valuable subject which exists outside the classroom and which has real, practical applications.

In addition to mathematics students will be involved in discussions, the writing of journals, environmental issues as well as developing social skills and improving self-image and self-motivation.

GOALS.

To provide students with opportunities to:

- understand mathematics as a way of thinking and an aid to solving practical problems.
- explore mathematics in a non classroom environment.
- solve problems in an atmosphere of friendly cooperation.

RESEARCH.

As part of my research project for my master's degree I will be trying to measure any changes in attitude to mathematics of the students as a result of the camp.
QUESTIONS and COMMENTS.

a) As far as I know, no one has organised a mathematics camp for elementary students so this may be a first!

b) Can the camp be held from Wednesday afternoon, 22 April, to Friday afternoon, 24 April? Staff would consist of the three grade 6 teachers, myself and, possibly, two or three others, selected from Collingwood staff, parents, senior students and other interested parties.

c) What funds or resources are available to help finance such a new and exciting venture?

d) Would you like to write an article, in the news letter, about the camp before I send any information, questionnaires etc home to the parents?

e) Would it be appropriate for me to approach sponsors regarding donations of prizes, posters etc?

I look forward to your comments and suggestions.
March 30, 1992

Chairperson
Ethics Committee
Simon Fraser University
Burnaby Mountain
Burnaby, B.C.
V5A 1S6

Dear Sir/Madam,

I have discussed with Jim Mennie his research project and am pleased to give it my support.

Sincerely,

Graham Baldwin,
Headmaster

GB/sjw
Dear parents,

It is with considerable pleasure that I can announce that the Mathematics Explorations Camp for Grade 6 Collingwood students will take place from the 6th until the 8th of April, 1992, and will be held at Sasamat Outdoor Centre in Belcarra.

The objectives of the camp are:

- to provide enjoyable mathematical experiences in a non classroom environment.
- to provide interesting mathematical activities related to the every day world.
- to provide opportunities for students to work cooperatively and to solve problems in cooperation with one another.
- to strengthen and extend students' understanding of mathematics.
- to encourage students to share their thoughts, feelings and experiences in both written and oral forms.
- to improve students' self esteem, confidence and motivation.

A grade 6 camp which focuses on mathematics is not only a first for Collingwood it is, as far as my research indicates, a first in Canada. Science camps for elementary students are not uncommon and maths camps have been held for grade 8 to 12 students in England, Australia, the US and Canada.

The exposure to mathematics in a non classroom environment will, I feel sure, be both an enjoyable and a rewarding experience for all the students and staff who attend the camp. I hope you will support this venture and encourage your child to participate in the camp.

As part of a research project I am undertaking through Simon Fraser University I would like to collect some information from the grade 6 students and their parents. The information will be collected by means of questionnaires issued to students, teachers and parents both before and after the camp and, possibly, through interviews with students.

All the information collected will be treated in the strictest confidence and only the results will be published. These results, together with details of the planning, the organisation and the activities undertaken at the camp could provide a useful framework for other schools who wish to run mathematics camps.

It is a requirement of Simon Fraser University that, before any research information can be collected from individuals their written permission, or, in the case of children, the permission of their parents or guardians, be obtained. For this reason I would be grateful if you could fill out and return the attached permission form by Wednesday March 11, 1992.

Yours sincerely,

Jim Mennie.
RESEARCH AGREEMENT

I understand that all information collected will be treated with complete confidentiality and no reference will be made in the research to any individual or individuals.

I also understand that I can withdraw from the project at any time.

I am willing to participate in Mr. Mennie's research project by filling out questionnaires before and after the Mathematics Explorations Camp in April and also agree to being interviewed by Mr. Mennie if so requested.

______________________________
Student signature

I agree to my son/daughter participating in Mr. Mennie's research project which requires that my son/daughter fill out questionnaires before and after the Mathematics Explorations Camp in April and that he/she be interviewed by Mr. Mennie if so requested.

I also agree to fill out questionnaires before and after the camp.

______________________________
Parent signature

CAMP ENROLMENT FORM

Dates: 6 - 8 April 1992

Location: Sasamat Outdoor Centre
Belcarra, BC

Cost: Accommodation, meals, transport $65.00
      Special T shirt designed by students $10.00
      $75.00

Students will leave Collingwood at 9 am on Monday April 6 and arrive back at Collingwood at lunch time on Wednesday April 8.
Students are expected to arrive at school at the regular time on the Monday and will be free to leave at the normal time on Wednesday.
Equipment lists etc will be available immediately after Spring Break.
Please complete and return the attached form by Wednesday March 11, 1992.

______________________________
I agree to my son/daughter _______________________(print name) attending the Maths Exploration Camp from 6 - 8 April 1992.

Please charge $_____ (S75 with T shirt, $65 without T shirt) to my bursar account.

(Date)________________________ Signature ____________________
Directions to Sasamat Camp

The loco turn-off is reached by heading east from Port Moody or west from the Coquitlam shopping centre.

Turn north on loco Road and follow the signs to Belcarra.

Turn right on Senkler Rd., at the Sasamat Camp sign about .5 km past the lake.

Camp phone: 939-2268
APPENDIX B

CAMP ACTIVITIES

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GRADE 6 MATHS EXPLORATIONS CAMP 3rd Draft Outline

(Rules and regulations, team allocation etc given out previously?)

Monday Leave Collingwood 9 am
Arrive Sasarnat 10.30 am

Disperse to cabins, report to main building for instructions
(Allow only a few minutes for this exercise!)
(Students will be restless and ready for activities).

ACTIVITY 1.  Give 10 minutes to explore camp and check location of all significant areas.
Return to lodge when summoned.

STAFF DISPERSED THROUGHOUT CAMP FOR "BEHAVIOURAL SUPERVISION", ESPECIALLY THE DOCK AREA.

Give each group 4 blank maps of area.
1 neat map to be handed in, 1 neat map for team use, 2 maps for rough work before making final copies.
Each team marks in the location of all significant areas/buildings etc, approximately to scale. Use colour pens or coloured sticky paper to produce an attractive, useful map.
(Have "solution" available on an overlay)

Staff to debrief teams.

11.30 approx Rules and Regulations etc

Review of behavioural expectations
Keeping journals and portfolios, both individual and team.
Team name, logo etc - to be ready for tonight
Description of how activities are to be tackled.

ACTIVITY 2. Give each team a strip of (surveyors) tape with a number on it (so that it can be traced back to the team). Challenge is to attach the tape to the highest point on any tree in the camp area. The highest tape wins. Must be able to remove the tape when activity finished.

STAFF DISPERSED THROUGHOUT CAMP TO OVERSEE AND PREVENT HAZARDOUS ACTIONS.

Staff to debrief.
Lunch 12.30. (2 teams on duty before and after lunch).

After lunch 1/2 an hour of "down time" to allow settling in to cabins, discussion of team names, logos etc.

1.30 - 3.00 Major activities
   Each team is (randomly) assigned 2 activities from:
   (a third activity will be assigned for those teams finished quickly).

   A) Find perimeter and area of swimming area.

   B) Find skin area and volume of a student

   C) Find the height of a tree (close to canoe shed) by more than 1 method. (Use hypsometer ?)

   D) Calculate the number of logs or trees required to fill the "wood shed".

   E) Water flow problem

   F) Find the area of the grassy area (Pick's theorem?)
      (More than 1 way)

   G) Connect all the cabins etc to the main building by covered walk ways. How much material required?

   H) Activity involving rain measurement

STAFF ASSIGNED TO DIFFERENT AREAS TO ACT AS MENTORS.

Debriefing will be required after each activity

3.00 Approx Snack

1/2 hour free time for games, walking, quiet time etc.
If going for a walk off the camp grounds must be accompanied by a teacher.

SOME STAFF ON DUTY.
3.30 Approx. Teams to build a straw tower which will support a tennis ball. Towers will then be tested to "destruction" with weights. Teams have to remember their construction as the towers may have to be rebuilt for parents to see.

NOT ALL STAFF REQUIRED TO BE ON DUTY.

Debriefing

4.30. Environment game, including graphs and discussions

Journals

5.30 Supper (2 teams on duty before and after)

Evening. Team names, logos, make badges (to be worn at all times)

Theatre sports (outside) plus ideas for skits.

TIME OFF FOR SOME STAFF.

Kaleidocycles (Work in pairs)
A) Show one
B) Students make one each
C) Students colour one before making it.

TIME OFF FOR SOME STAFF.

Darkness activity.
Each team given a set of clues which will lead to a set of maths questions which have to be answered.

ALL STAFF ON DUTY

Campfire, sing song, marshmallow/wiener roast.
Possibly 1 team on duty.

TIME OFF FOR SOME STAFF

Bed

ALL STAFF ON DUTY

STAFF DEBRIEFING/PLANNING
**TUESDAY** Before breakfast walk, run, aerobics for all students.

**8.30 Breakfast** (2 teams on duty before and after)

Teams will be assigned to activities A, B or C. They will work on first set of activities until mid morning break then switch to second set till lunch time. After lunch they will switch to the third set. Teams to complete as many activities as possible, in any order.

ALL STAFF AND STUDENT LEADERS WILL BE DIVIDED AMONG THE ACTIVITIES AND WILL ROTATE TO EACH SET OF ACTIVITIES.

Debriefing after each activity.

**ACTIVITIES A (At White Pine Beach - 20 walk?)**

a) Estimate 100 m, measure accurately, run 100 m and time, find average time, speed. Figure out where you would be if you were racing against the world record holder.

b) Given a rope enclose the largest area, justify your answer. Find the area between 2 (concentric) circles formed from 2 ropes.

c) Money trail - what would be the value of a trail of quarters laid from point A to point B.

d) Rate of growth. If you started to grow 270 days before you were born what was your average daily growth rate until now?

e) Estimate the distance from the camp gate to the concession.

**ACTIVITIES B.**

a) Find 1 000 000 (+ answers to some exercises)

b) Blind walk. Write instructions for a blind person to travel from A to B

c) Find the perimeter and area of a large leaf or fern.

d) Measure heart rate, body temp before and after a short sprint. Measure at 30 sec intervals. Graph results.

e) Estimate the area of the camp site.
f) EITHER How much cable would be required if all the cabins had to be connected to the main buildings via telephone?

OR What is the shortest distance and the route you would follow if you had to deliver a message to each building, starting and finishing at the main office?

ACTIVITIES C.(Indoors?)

a) Redesign your cabin. Also make it a "duplex". (Check if they use slide or reflect)

b) Support structure problem (see grade 8 camp)

c) Given a circle of paper, make the cone of largest volume.

d) 8 queens chess problem.

e) 4 games. Each team member has to be allocated to one game then he/she will compete against other teams.(???) (Connect 4, Tic tac toe, JM game, ...)

f) Budget exercise. Make a budget for running a camp or given the budget and the costs how can you run the camp.

12.30 Lunch  (2 teams on duty before and after).

ACTIVITIES A, B, C.

2.30 Approx.  Journals/free time
              Snack
              Games/walk/free time

ALL/SOME STAFF ON DUTY

4.00  Mathematical treasure hunt + display
       Skit preparation.

ALL/SOME STAFF ON DUTY.

5.30 Supper  (2 teams on duty before and after).
Evening. Games - league competitions

4 STAFF AND 4 STUDENTS ON DUTY

Skits

SOME STAFF ON DUTY

Campfire, cooking, sing along
(Possibly one team on duty, same one as last night)

Bed ALL STAFF ON DUTY

STAFF DEBRIEFING/PLANNING

WEDNESDAY (Before breakfast walk, run, aerobics for all students)
Cabins have to be tidied and students packed and out by 9 am.

8.30 Breakfast (2 teams on duty before and after).

1 Activity - need a good "finishing" activity
Debriefing, journals, closing activities etc

11.30 ? Depart for Collingwood.
Mathematical lunch ??

Afternoon Debriefing, questionnaires, regular classes ???
ACTIVITY 1 - CAMP MAP.

Equipment.  
4 blank maps  
Measuring tape  
Pens, pencils, paper

Instructions.  
2 maps are to be used for rough work  
1 completed map is to be handed in  
1 completed map is to be kept for team use.

Complete the maps by marking in all buildings and other significant features.

Each map should show:

- main lodge
- cottages A, B, C, D
- summer cabins 1, 2, 3, 5, 6, 7, 8
- two classroom buildings
- tool shed
- canoe shed
- change rooms
- parking lot
- fire pit, etc.
ACTIVITY 2 - SKY HIGH.

**Equipment**
Approximately 50 cm of coloured tape.

**Instructions**
Attach the tape to the highest point on any tree within the camp grounds.

The tape which is highest wins.

The tapes must be removed after the activity!
MAJOR ACTIVITY A - OVER AND AROUND.

**Equipment**
- Measuring tape
- Paper, pens, pencils
- Calculator

**Instructions**
Discuss in your team how you could obtain the best estimate of the perimeter and area of the "swimming area".

Obtain the best estimate of the area and perimeter of the "swimming area".

Record the strategies you used, whether you consider them successful or not.
MAJOR ACTIVITY B - SKINNED ALIVE.

**Equipment**
- Short measuring tape
- Paper, pens, pencils
- Calculator

**Instructions**
Discuss in your team how you would attempt to find the area of skin required to cover one team member.

Obtain the best estimate of the skin area of one member of the team.

Record your strategies, whether successful or not.

(How would you set about finding the volume of one member of your team?)
MAJOR ACTIVITY C - REACH FOR THE TOP.

Equipment

Tape
Hypsometer and instruction sheet
Clinometer and instruction sheet
Paper, pens, pencils
Calculator.

Instructions

1. Each team member will estimate the height of the large tree beside the canoe shed. Calculate the average of your answers.

2. Use the Hypsometer to estimate the height of the tree.

3. Use the clinometer to estimate the height of the tree.

Which method do you consider to be the most accurate?
MAJOR ACTIVITY D - A CHIP OFF THE OLD BLOCK.

**Equipment**
- Tape
- Paper, pens, pencils
- Calculator

**Instructions**
In order to have enough logs for the winter, part of the verandah of the lodge is to be used for storing logs.

Discuss in your team how you would estimate the number of logs which could be stored on the verandah.

Obtain the best estimate of the number of logs which could be stored.

Describe how you tackled the problem.
MAJOR ACTIVITY E - THE FLOODS ARE COMING.

Equipment

Tape
Paper, pens, pencils
Calculator
(Stop watch)

Instructions

1. If water was flowing over the "dam" what do you think the rate of flow would be?

2. If the water was 15 cm deep how much water do you think would flow over the "dam" in 1 second, 1 minute?

Describe all the strategies you used, whether you consider them successful or not.
MAJOR ACTIVITY F - PEGGING THE AREA.

**Equipment**

- Tape
- "Pegs" and instructions for Pick's method
- Paper, pens, pencils
- Calculator

**Instructions**

Obtain an estimate of the area of the grassy area beside the car park by:

a) estimation

b) measurement

c) Pick's method

Which method do you consider to be the most accurate?

Record your strategies, whether or not you consider them to be successful.
MAJOR ACTIVITY G - THE RAINS ARE COMING.

Equipment
- Tape
- Paper, pens, pencils
- Calculator

Instructions
Assume all the cottages are to be connected to the main lodge by covered walkways.

Discuss in your group how you would set about designing the system.

Obtain your best estimate of the amount of material you would require for the construction based on your design.
ACTIVITIES A (At White Pine Beach)

You will not have time to complete all of these activities. You should agree as a team which ones you will try.

Record your strategies, whether or not you consider them to be successful.

Equipment
- Measuring tape, stop watch, ropes, quarter(s),
- Paper, pens, pencils, calculator.
- World record for the 100 m. Men -
  - Women -

a) Instructions
- Estimate a distance of 100 m
- Measure off a distance of 100 m
- Calculate your error from the formula
  \[ \frac{(Estimate - 100) \times 100\%}{100} \]
- Measure the time for each person to run 100 m
- Calculate your average speed in m/sec
- Calculate the distance you would cover in the time taken for the world record holder to run 100 m
- Stand at the place you would be if you raced against the world record holder and he/she was at the finish line.
b) Instructions - Use the rope to enclose the largest possible area.
- What is the area
- Justify your answer.
- Can you find the area between 2 (concentric) circles formed from 2 ropes.

c) Instructions - Estimate the value of a trail of quarters from to
- What would be the value of 1 km of quarters?

d) Instructions - If you started to grow 270 days before you were born estimate your average daily growth until now.

e) Instructions - Estimate the distance from the camp gate to the concession
ACTIVITIES B

You will not have time to complete all of these activities. You should agree as a team which ones you will try.

Record your strategies, whether or not you consider them to be successful.

Equipment
- "Leaf", acetate sheet, maps, stop watch, thermometer, tape, thread.
- Paper, graph paper, pens, pencils, calculator.
- Recording sheet for activity d)

a) Instructions
- Find an example of 1 000 000
- Estimate how long it would take you to count to 1 million
- Are you more or less than 10 million minutes old? How old is a person who is 10 million minutes old?
- If you were given $1 000 000 on your 11th birthday and you spent an average of $1 per hour for 12 hours per day, what age would you be when you have no money left?
b) Instructions  - Write a set of verbal instructions for a blind person to walk from _______ to ________
               - Test your instructions

c) Instructions  - Estimate the perimeter and area of the large "leaf".

d) Instructions  - Mark off a sprint distance of approx 30 metres
               - You are going to measure your heart rate and body temperature at 30 second intervals starting 2 minutes before you sprint and finishing 2 minutes after you sprint.
               - To measure heart rate take pulse for 30 seconds and multiply by 2.
               - Use the recording chart for collecting the data.
               - Graph the results.
e) Instructions - Obtain your best estimate of the area of the camp site.

f) Instructions - Attempt either i) or ii)

i) Estimate the minimum length of telephone cable you would use if you were to connect cottages A, B, C, D to the main building by telephone.

Show the cable routes on a map.

ii) Estimate the minimum distance you would travel if you had to deliver a message to each of the cottages, the tool shed and the canoe shed. You have to start and finish at the main lodge.

Show your route on a map.
ACTIVITIES C (INDOORS OR ON THE VERANDAH)

You will not have time to complete all of these activities. You should agree as a team which ones you will try.

Record any strategies you use whether or not you consider them to be successful.

Equipment
- Ruler, pens, pencils, paper, scissors, calculator
- Styrofoam cups, pick up sticks, paper circles, "rice", chess board, games, counters.

a) Instructions
- If you were to redesign your "double" cabin what changes would you make?
  
  Draw a plan of your redesigned cabin.

b) Instructions
- Use 3 cups to create a platform to support the fourth cup which contains the weight.
  
  THE 3 CUPS MUST BE FURTHER AWAY THAN THE LENGTH OF A PICK UP STICK FROM EACH OTHER.

  You cannot punch holes in the cups (It is impossible to do this alone)
c) Instructions - Using a paper circle and scissors make a cone with the largest volume.

d) Instructions - You require the chess board and 8 counters.
- A counter can move in a straight line horizontally, vertically or diagonally on the board to eliminate any other piece.
- The challenge is to place the 8 counters on the board so that every square is protected. e.g., if a ninth piece is placed on the board it can be eliminated.

e) Instructions - Play the games
- Decide which one you prefer and give a reason.

f) Instructions - Budget exercise
TREASURE HUNT.

Try to find as many of the following items as possible.

Mark their location on the map

Describe each item

Give your team 2 points for each item which occurs naturally and 1 point if it is "man made".

You may pick one naturally occurring and one man made item in each category.

1. Rectangle
2. Trapezoid
3. Circle
4. Parallel lines
5. Intersecting lines
6. Straight line
7. Cylinder
8. Arc
9. Acute angle
10. Sphere

11. Perpendicular lines
12. Triangle
13. Symmetrical shape, 1 axes of symmetry
14. Symmetrical shape, more than 1 axes of symmetry
15. Right angle
16. Hexagon
17. Prism
18. Square
19. Polygon, a different shape from any used above

20 BONUS Any mathematical shape which could not be used in any of the previous answers.
Oh Deer!

Objectives: Students will be able to:
1) identify and describe food, water, and shelter as three essential components of habitat; 2) describe the importance of good habitat for animals; 3) define "limiting factors" and give examples; and 4) recognize that some fluctuations in wildlife populations are natural as ecological systems undergo a constant change.

Method: Students become "deer" and components of habitat in a highly involving physical activity.

Background: A variety of factors affects the ability of wildlife to successfully reproduce and to maintain their populations over time. Disease, predator/prey relationships, varying impacts of weather conditions from season to season (e.g., early freezing, heavy snows, flooding, drought), accidents, environmental pollution, and habitat destruction and degradation are among these factors.

Some naturally-caused as well as culturally-induced limiting factors serve to prevent wildlife populations from reproducing at numbers greater than their habitat can support. An excess of such limiting factors, however, leads to thinning, endangering, and eliminating whole species of animals.

The most fundamental of all necessary for any animal are food, water, shelter, and space in a suitable arrangement. Without these essential components, animals cannot survive.

This activity is designed for students to learn that:
- good habitat is the key to wildlife survival;
- a population will continue to increase in size until some limiting factors are imposed;
- limiting factors contribute to fluctuations in wildlife populations; and
- nature is never in "balance", but is constantly changing.

Wildlife populations are not static. They continuously fluctuate in response to a variety of stimulating and limiting factors. We tend to speak of limiting factors as applying to a single species, although one factor may affect many species. Natural limiting factors, or those modeled after factors in natural systems, tend to maintain populations of species at levels within predictable ranges. This kind of "balance in nature" is not.

From: Project Wild, published by the Canadian Wildlife Federation
static, but is more like a teeter-totter than a balance. Some species fluctuate or cycle annually. Quail, for example, may start with a population of 100 pairs in early spring; grow to a population of 1200 birds by late spring; and decline slowly to a winter population of 100 pairs again. This cycle appears to be almost totally controlled by the habitat components of food, water, shelter, and space, which are also limiting factors. Habitat components are the most fundamental and thereby the most critical of limiting factors in most natural settings.

This activity is intended to be a simple but powerful way for students to grasp some basic concepts: that everything in natural systems is interrelated; that populations of organisms are continuously affected by elements of their environment; and that populations of animals do not stay at the same static number year after year in their environment, but rather are continually changing in process of maintaining dynamic equilibria in natural systems.

The major purpose of this activity is for students to understand the importance of suitable habitat as well as factors that may affect wildlife populations in constantly changing ecosystems.

Materials area — either indoors or outdoors — large enough for students to run; e.g., playing field; chalkboard or flip chart; writing materials

Procedure
1. Begin by telling students that they are about to participate in an activity that emphasizes the most essential things that animals need in order to survive. Review the essential components of habitat with the students: food, water, shelter, and space in a suitable arrangement. This activity emphasizes three of those habitat components — food, water, and shelter — but the students should not forget the importance of the animals having sufficient space in which to live, and that all the components have to be in a suitable arrangement or the animals will die.
2. Ask your students to count off in four’s. Have all the one’s go to one area; all two’s, three’s and four’s go together to another area. Mark two parallel lines on the ground or floor nine to 18 metres apart. Have the one’s line up behind one line; the rest of the students line up behind the other line.
3. The one’s become “deer”. All deer need good habitat in order to survive. Ask the students what the essential components of habitat are again: food, water, shelter, and space in a suitable arrangement. For the purposes of this activity, we will assume that the deer have enough space in which to live. We are emphasizing food, water, and shelter. The deer (the one’s) need to find food, water, and shelter in order to survive. When a deer is looking for food, it should clamp its hands over its stomach. When it is looking for water, it puts its hands over its mouth. When it is looking for shelter, it holds its hands together over its head. A deer can choose to look for any one of its needs during each round or segment of the activity; the deer cannot, however, change what it is looking for; e.g., when it sees what is available, during that round, it can change again what it is looking for in the next round, if it survives.
4. The two’s, three’s, and four’s are food, water, and shelter — components of habitat. Each student gets to choose at the beginning of each round which component he or she will be during that round. The students depict which component they are in the same way the deer show what they looking for; that is, hands on stomach for food, etc.
5. The game starts with all players lined up on their respective lines (deer on one side; habitat components on the other side) — and with their backs to the students at the other line.
6. The facilitator or teacher begins the first round by asking all of the students to make their signs — each deer deciding what it is looking for, each habitat component deciding what it is. Give the students a few moments to get their hands in place — over stomachs, mouths, or over their heads. (As you look at the two lines of students, you will normally see a lot of variety — with some students water, some food, some shelter. As the game proceeds, sometimes the students confer with each other and all make the same sign. That’s okay, although don’t encourage it. For example, all the students in habitat might decide to be shelter. That could represent a drought year with no available food or water.)
7. When you can see that the students are ready, count: “One . . . two . . . three”. At the count of three, each deer and each habitat component turn to face the opposite group, continuing to hold their signs clearly.
8. When deer see the habitat component they need, they are to run to it. Each deer must hold the sign of what it is looking for until getting to the habitat component person with the same sign. Each deer that reaches its necessary habitat component takes the “food”, “water”, or “shelter” back to the
deer side of the line. This is to represent the deer's successfully meeting its needs, and successfully reproducing as a result. Any deer that fails to find its food, water, or shelter dies and becomes part of the habitat.

That is, in the next round, the deer that died is a habitat component and so is available as food, water, or shelter to the deer who are still alive.

NOTE: When more than one deer reaches a habitat component, the student who gets there first survives. Habitat components stay in place on their line until a deer needs them. If no deer needs a particular habitat component during a round, the habitat component just stays where it is in the habitat. The habitat person can, however, change which component it is from round to round.

9. You as the facilitator or teacher keep track of how many deer there are at the beginning of the game, and at the end of each round you record the number of deer also. Continue the game for approximately 15 rounds. Keep the pace brisk, and the students will thoroughly enjoy it.

10. At the end of the 15 rounds, gather the students together to discuss the activity. Encourage them to talk about what they experienced and saw. For example, they saw a small herd of deer (seven students in a class size of 23) begin by finding more than enough of its habitat needs. The population of deer expanded over two to three rounds of the game, until the habitat was depleted and there was not sufficient food, water, and shelter for all the members of the herd. At that point, deer starved or died of thirst or lack of shelter, and they returned as part of the habitat. Such things happen in nature also.

11. Using a flip chart pad or an available chalkboard, post the data recorded during the game. The number of deer at the beginning of the game and at the end of each round represent the number of deer in a series of years. That is, the beginning of the game is year one; each round is an additional year. Deer can be posted by five's for convenience. For example:

```
<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Deer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5, 5, 5, 5, 5</td>
</tr>
<tr>
<td>2</td>
<td>3, 3, 3, 3, 3</td>
</tr>
<tr>
<td>3</td>
<td>0, 0, 0, 0, 0</td>
</tr>
<tr>
<td>4</td>
<td>0, 0, 0, 0, 0</td>
</tr>
<tr>
<td>5</td>
<td>0, 0, 0, 0, 0</td>
</tr>
</tbody>
</table>
```

The students will see this visual reminder of what they experienced during the game: the deer population fluctuated over a period of years. This is a natural process, as long as the factors which limit the population do not become excessive, to the point where the animals cannot successfully reproduce. The wildlife populations will tend to peak and rebuild, peak and rebuild, as long as there is good habitat and sufficient numbers of animals to successfully reproduce.

12. In discussion, ask the students to summarize some of the things they have learned from this activity. What do animals need to survive? What are some of the "limiting factors" that affect their survival? Are wildlife populations static, or do they tend to fluctuate, as part of an overall "balance of nature"? Is nature ever really in "balance", or are ecological systems involved in a process of constant change?

Extensions

1. When you have finished tabulating the graze data and discussing it, ask the students if they have ever heard of the Hudson Bay trappers in Canadian history. Tell them, briefly, who they were.

There is a hundred years, or more, of records of the activities of these trappers. In those records are some interesting data. These data refer to pelts shipped from North America to Europe, particularly the pelts of snowshoe hares and lynx.
Researchers have found that snowshoe hare populations seem to peak about every seven to nine years and then crash, repeating the process over each comparable time period. So, a snowshoe hare population graph would look like this:

![Graph of snowshoe hare population]

It has also been discovered that lynx populations do the same thing — except that they do it one year behind the hare populations. The combined graph would look like this:

![Combined graph of snowshoe hare and lynx populations]

2. Some recent research has added a new dimension to the story of the snowshoe hares and the lynx. It has been found that the major food of the hare is a small willow. As hare populations grow, the use of the willow plants grows too. But, when the willow plant has been "hedged" or eaten back so far, the plant generates a toxin (poison) which precludes use by the hare. That is when the hare population crashes, followed by the crash of the lynx population about a year later. Then the willow, relieved of pressure, begins to grow again. The hare population begins to grow in response, and last of all, within a year or so, the lynx population follows. And the cycle has begun again — over and over — every seven to nine years. Discuss the "balance of nature". Is it ever in "balance"?

**Evaluation**

Name three essential components of habitat.

Define "limiting factors". Give three examples.

Examine the graph. What factors may have caused the following population changes:

a. between years 1 and 2?

b. between years 3 and 4?

c. between years 5 and 6?

d. between years 7 and 8?

![Graph of population changes]

Which of the following graphs represents the more typically balanced population?

![Graph of more balanced population]

---

119
Kaleidocycles

To build a kaleidocycle you need the following materials:

1. One piece of heavy, but flexible, paper.
2. Pencil and ruler.
3. Knitting needle or something with a similar blunt point.
4. Scissors.
5. Glue (rubber cement is good).
6. Felt pens or paints for decorating.
7. Patience.

Now, proceed along the following steps:

A. Copy the pattern onto the paper and cut it out.
B. Use the ruler to score along all lines with the knitting needle.
C. Fold front-to-front on all the thick vertical lines.
D. Fold back-to-back on all the diagonal lines.
E. Hold the folded paper in your hand and moving it slowly let it naturally fall into the desired shape.
F. Put glue on the shaded triangles and glue them underneath.
G. Put glue on the two "tabs" and carefully insert them into the other open end.
H. Paint on whatever patterns you wish and look for "new" patterns that appear as you rotate the kaleidocycle.

Department of Mathematics and Statistics
Simon Fraser University
October, 1991
APPENDIX C

PROBLEMS DESIGNED BY STUDENTS AT CAMP

(Includes team names)
Problems 1 and 2 were designed by the "Dividors" and the "Mad Mathematicians".

1. 66 students each drank a cup of hot chocolate and 34% of them went back for a second cup; 46% of the second group went back for a third cup and 20% of these managed a fourth cup. How many cups of hot chocolate were consumed? How much hot chocolate was drunk if each cup contained 200 ml?

2. You are out in the woods and you wish to light a fire which will burn for as long as possible. You have 10 alder logs each of which will burn for 8 minutes, 8 poplar logs each of which will burn for 7 minutes, 10 Cedar logs each of which will burn for 21 minutes, and 9 Birch logs each of which will burn for 9 minutes. If you have 3 logs on the fire at any given time how long will the fire last?

Question 3 was designed by the "Human Calculators".

3. A raft has a length of 7 metres, a width of 1.5 metres, and a depth of 75 centimetres. If it rains twice a week and each time it rains an average of 8 millimetres of rain falls on the raft, how long will it be before the raft is full of water?
Question 4 was designed by the "Rulers" and the "Whiz Kids".

4. Rory ate 5 slices of french toast on the first of June. Each day he ate two more slices than on the previous day. On what day did he eat his 1000th slice of toast?

For every 30 slices of toast Rory used up one 750 ml bottle of maple syrup. How many bottles had he used by the time he ate his 1000th slice of toast?

Question 5 was designed by the "Mathematical Wizards".

5. If you were to redesign the baseball park beside the school into a swimming area how would you do it?

Question 6 was designed by "Minus".

6. How many hectares of forest are destroyed every second, hour, day, year?

How long before there are no trees left?

Question 7 was designed by "Guess Again".

7. The boat dock is 14.6 metres long and 3.43 metres wide. If it is constructed of boards 2.33 metres long, and 28 centimetres wide and each board requires an average of six nails, how many nails were used to make the dock?
Question 8 was designed by the "Mathematical Muts".

8. There is a dock which is 2 metres by 10 metres. You are going to cover it with pieces of wood which are 50 cm by 10 cm. How many pieces of wood does it take to cover the dock?

Question 9 was designed by the "Problems".

9. Find the volume of a tree.

Question 10 was designed by "Mathallica".

10. A rectangle measures 31 metres by 14 metres. Two circular holes, one of diameter 13 metres and the other of diameter 3 metres are removed. What is the area of the remaining wood?

Question 11 was designed by the "Addition Addics".

11. A lake has an area of 180 square metres.
   a) If the lake is circular what is its diameter?
   b) If the lake is triangular with a base of 20 metres, what is its "height"?
APPENDIX D

QUESTIONNAIRES

Questionnaire A ........................................ 127
Questionnaire B ........................................ 134
Questionnaire B (POST) ................................ 135
Questionnaire C ........................................ 136
Questionnaire C (POST) ................................ 138
Questionnaire D ........................................ 139
Parent Questionnaire ................................. 140
Parent Questionnaire B ............................... 142
Camp Evaluation ....................................... 144

Questionnaire A contains the percentage of responses in pre- and post- questionnaires. The first row gives pre- camp responses, the second row gives post- camp and the third row, where it appears, the responses to the questions given to the students eight weeks after the camp.

Questionnaire C contains the average number of responses in each category for both pre- and post-questionnaires.

The Parent Questionnaires and the Camp Evaluation contain the percentage of responses in each category.
Questionnaire A (Pre-, Post- and 8 Weeks)

Attitudes

There are no right or wrong answers. The only correct responses are those that are true for you.

This questionnaire is being used for research purposes and no one will know what your responses are.

In this section circle the comment that best describes your feelings about the statements below.

1. The mathematics I learn in school

a) is mostly facts and procedures which have to be memorised.

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b) helps me to think clearly.

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c) doesn't seem to have much use outside of school.

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2. a) Some people are naturally good at Mathematics and some are not.

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b) Some people are naturally good at English and some are not.

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c) Some people are naturally good at Social Studies and some are not.

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d) Some people are naturally good at PE and some are not.

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3. In mathematics there is either a right or wrong answer to every problem.

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4. Mathematics is very important if I am going to get a good job.

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5. There is only one correct way to solve mathematics problems.

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6. In mathematics you can be creative.

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7. In mathematics you can discover things by yourself.

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8. The best way to be good at mathematics is to memorise all the rules and formulas.

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9. I cannot do mathematics unless someone shows me how to do it first.

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10. To solve problems you have to be taught the correct procedures or you cannot do anything.

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11. I study mathematics because

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b) I have to.

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c) it helps me to think more clearly.

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d) it is important.

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e) my parents tell me it is important.

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12. As I get older, being able to understand mathematics will become more important.

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13. Most people use mathematics in their jobs.

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14. Where would you rank yourself as a mathematics student?

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For questions 18-22, write a few words to complete the sentence.

18. The thing I like best about mathematics is...

19. The thing I like least about mathematics is...

20. The thing that makes me feel good in mathematics is...

21. The thing that makes me feel bad in mathematics is...

22. The scariest thing about mathematics is...

23. Under each of the statements below, circle the number which best represents your LIKE or DISLIKE of the topic.

1. Means you like the topic very much.
2. Means you like the topic.
3. Means you neither like nor dislike the topic.
4. Means you dislike the topic.
5. Means you dislike the topic very much.

a) Number Operations (addition, subtraction, multiplication, division, etc).

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b) Measurement (perimeter, area, volume, etc).

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c) Geometry (shapes, flips, slides, turns etc).

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d) Data Analysis (circle graphs, bar graphs etc).

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e) Estimation.

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f) Calculators/computers.

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g) Problem solving.

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24. Under each of the statements below, circle the number which best represents your view of the IMPORTANCE of the topic.

1. Means you feel the topic is very important.
2. Means you feel the topic is important.
3. Means you don’t know or have no opinion about the importance of the topic.
4. Means you feel the topic is not very important.
5. Means you feel the topic is extremely unimportant.

a) Number Operations (addition, subtraction, multiplication, division, etc).

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b) Measurement (perimeter, area, volume, etc).

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c) Geometry (shapes, flips, slides, turns etc).

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d) Data Analysis (circle graphs, bar graphs etc).

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e) Estimation.

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f) Calculators/ computers.

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g) Problem solving.

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</table>

25. The first word(s) which come to mind when I think about mathematics is/are...

26. Your teacher sometimes gives you projects in Social Studies or Science to complete. Would you like to complete such a project in mathematics?

If yes, why? If no, why?
Questionnaire B

Applications of Mathematics

Answer the following questions on a separate piece of paper.

1. After an earthquake in Mexico the Canadian Red Cross decided to send 1000 tonnes of emergency supplies.

   List as many different applications of mathematics as you can think of which you might use if you were helping to plan this relief project.

2. What mathematics is suggested by the following pictures?
   a) 
   b) 
   c)
Questionnaire B (Post)

Applications of Mathematics

Answer the following questions on a separate piece of paper.

1. A construction company is planning to move 100 tonnes of equipment from one part of the city to another.

   List as many different applications of mathematics as you can think of which you might use if you were helping to plan this operation.

2. What mathematics is suggested by the following pictures?

   a)  
   
   b)  

   Parquet flooring

   c)
**Questionnaire C**

**Mathematical Connections**

On the next page you are given a list of 7 mathematical categories plus a space for you to write in your own category. Place words and/or phrases from the list below opposite each category and state the connections which led you to place it in that category.

Note: many words or phrases can fit a number of categories.

<table>
<thead>
<tr>
<th>sailing boat</th>
<th>bike</th>
<th>telephone</th>
</tr>
</thead>
<tbody>
<tr>
<td>thermometer</td>
<td>tent</td>
<td>kite</td>
</tr>
<tr>
<td>clock</td>
<td>loonies</td>
<td>3 for $12.56</td>
</tr>
<tr>
<td>STOP sign</td>
<td>mirror</td>
<td>ball</td>
</tr>
<tr>
<td>can of soup</td>
<td>calendar</td>
<td>apple pie</td>
</tr>
<tr>
<td>cobweb</td>
<td>football pitch</td>
<td>dice</td>
</tr>
<tr>
<td>playing cards</td>
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</tr>
<tr>
<td>1. POLYGONS</td>
<td>Responses (x)</td>
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<td>4. RATE</td>
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<td>6. PATTERNS</td>
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<td>7. FLIPS, SLIDES, AND TURNS</td>
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<td>8. YOUR OWN CATEGORY</td>
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</table>
Mathematical Connections

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Note: many words or phrases can fit a number of categories.

- Dominoes
- Sunflower
- Speedometer
- Sailing boat
- Coke can
- Telephone
- Student timetable

<table>
<thead>
<tr>
<th>Category</th>
<th>Word 1</th>
<th>Word 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominoes</td>
<td>Ice rink</td>
<td>Ice cream cone</td>
</tr>
<tr>
<td>Sunflower</td>
<td>Juice carton</td>
<td>100 m in 12 sec</td>
</tr>
<tr>
<td>Speedometer</td>
<td>$5 bill</td>
<td>Hockey puck</td>
</tr>
<tr>
<td>Sailing boat</td>
<td>Skate board</td>
<td>Doughnut</td>
</tr>
<tr>
<td>Coke can</td>
<td>STOP sign</td>
<td>Paper plane</td>
</tr>
<tr>
<td>Telephone</td>
<td>Tennis racquet</td>
<td>Igloo</td>
</tr>
<tr>
<td>Student timetable</td>
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</tbody>
</table>
People in Mathematics

Describe ways in which you think the following people might use mathematics in their daily lives.

1. Bryan Adams - pop singer who makes hit records, travels all over the world giving concerts.

2. Roberta Bondar - Canadian woman astronaut who recently returned from 8 days in space where she carried out a number of scientific experiments.

3. Grant Connell - International tennis player from North Vancouver. He and his partner, Glenn Michibata, are among the best players in the world of professional tennis. He is currently playing in Japan and he recently played in Vancouver and Australia.

4. Mike Harcourt - Premier of British Columbia, leader of the N.D.P., and former mayor of Vancouver.

5. Your mother, step-mother or female guardian.
Parent Questionnaire

This questionnaire is intended to examine parental views on the mathematics in their children's education. There are no right or wrong answers. The only correct responses are those that are true for you. This questionnaire is being used for research purposes and no one will know what your responses are. Please circle the comment that best describes your feelings about the following statements.

1. My son/daughter will need mathematics for whatever career he/she decides to follow.

<table>
<thead>
<tr>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
<th>DON'T KNOW</th>
<th>DISAGREE</th>
<th>STRONGLY DISAGREE</th>
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<tr>
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<td>17%</td>
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</table>

2. It is important that my daughter/son should study mathematics throughout her/his school career.

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<tr>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
<th>DON'T KNOW</th>
<th>DISAGREE</th>
<th>STRONGLY DISAGREE</th>
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</table>

3. Does your son/daughter talk positively about mathematics when he/she comes home from school?

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<thead>
<tr>
<th>FREQUENTLY</th>
<th>SOMETIMES</th>
<th>DON'T KNOW</th>
<th>SELDOM</th>
<th>NEVER</th>
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</thead>
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</table>

4. Does your daughter/son talk negatively about mathematics when she/he comes home from school?

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<th>FREQUENTLY</th>
<th>SOMETIMES</th>
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<th>SELDOM</th>
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5. How frequently do you (or your spouse/partner) make positive comments to your son/daughter regarding mathematics (giving friendly encouragement, listening patiently etc)?

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<thead>
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<th>FREQUENTLY</th>
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</table>
6. How frequently do you (or your spouse/partner) make negative comments to your daughter/son regarding mathematics (claiming you were not good at maths at school, didn’t like maths etc)?

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<th>SOMETIMES</th>
<th>DON’T KNOW</th>
<th>SELDOM</th>
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<td>54%</td>
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7. Does your son/daughter enjoy games and puzzles that involve mathematical thinking ("Connect 4", cards, chess, jig-saw puzzles etc).

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8. Does your daughter/son ask you questions related to her/his mathematics homework?

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9. Does your son/daughter ask you questions related to mathematics in the world around him/her?

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<th>SOMETIMES</th>
<th>DON’T KNOW</th>
<th>SELDOM</th>
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<td>4%</td>
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10. Does your daughter/son show interest in working on mathematics other than her/his homework (speeds of cars, recipes for cooking, making patterns, measuring etc)?

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<tr>
<th>FREQUENTLY</th>
<th>SOMETIMES</th>
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11. Does your son/daughter show awareness of applications of mathematics in the world around him/her (sports statistics, space travel, patterns, holiday costs, schedules etc)?

<table>
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<tr>
<th>FREQUENTLY</th>
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12. Does your daughter/son get excited about a piece of mathematics?

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<th>SELDOM</th>
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<td>6%</td>
<td>33%</td>
<td>10%</td>
</tr>
</tbody>
</table>

141
Parent Questionnaire B

This questionnaire is intended to examine parental views on the role of mathematics in their children's education. There are no right or wrong answers. The only correct responses are those that are true for you. This questionnaire is being used for research purposes and no one will know what your responses are. Please read the questions carefully before circling the comment that best describes your feelings about the following statements.

1. Did your son/daughter talk positively about the maths camp when he/she returned home?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Sometimes</th>
<th>Don't Know</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>6%</td>
<td>69%</td>
<td>0%</td>
<td>19%</td>
<td>3%</td>
</tr>
</tbody>
</table>

2. Does your daughter/son still talk positively about the maths camp?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Sometimes</th>
<th>Don't Know</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>28%</td>
<td>6%</td>
<td>56%</td>
<td>9%</td>
</tr>
</tbody>
</table>

3. Did your son/daughter talk negatively about the maths camp when she/he returned home?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Sometimes</th>
<th>Don't Know</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>38%</td>
<td>13%</td>
<td>28%</td>
<td>22%</td>
</tr>
</tbody>
</table>

4. Does your daughter/son still talk negatively about the maths camp?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Sometimes</th>
<th>Don't Know</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>19%</td>
<td>6%</td>
<td>13%</td>
<td>63%</td>
</tr>
</tbody>
</table>

5. Did your son/daughter talk positively about the mathematics activities when he/she returned from the camp?

<table>
<thead>
<tr>
<th>Frequently</th>
<th>Sometimes</th>
<th>Don't Know</th>
<th>Seldom</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>6%</td>
<td>63%</td>
<td>3%</td>
<td>25%</td>
<td>3%</td>
</tr>
</tbody>
</table>
6. Does your daughter/son still talk positively about the mathematics activities of the camp?

<table>
<thead>
<tr>
<th>FREQUENTLY</th>
<th>SOMETIMES</th>
<th>DON'T KNOW</th>
<th>SELDOM</th>
<th>NEVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>13%</td>
<td>6%</td>
<td>41%</td>
<td>41%</td>
</tr>
</tbody>
</table>

7. Did your son/daughter talk negatively about the mathematics activities when she/he returned from the camp?

<table>
<thead>
<tr>
<th>FREQUENTLY</th>
<th>SOMETIMES</th>
<th>DON'T KNOW</th>
<th>SELDOM</th>
<th>NEVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>3%</td>
<td>28%</td>
<td>0%</td>
<td>28%</td>
<td>44%</td>
</tr>
</tbody>
</table>

8. Does your daughter/son still talk negatively about the mathematics activities of the camp?

<table>
<thead>
<tr>
<th>FREQUENTLY</th>
<th>SOMETIMES</th>
<th>DON'T KNOW</th>
<th>SELDOM</th>
<th>NEVER</th>
</tr>
</thead>
<tbody>
<tr>
<td>0%</td>
<td>16%</td>
<td>6%</td>
<td>9%</td>
<td>69%</td>
</tr>
</tbody>
</table>

9. I feel the maths camp was a valuable experience for my daughter/son.

<table>
<thead>
<tr>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
<th>DON'T AGREE</th>
<th>DISAGREE</th>
<th>STRONGLY DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>19%</td>
<td>59%</td>
<td>16%</td>
<td>6%</td>
<td>0%</td>
</tr>
</tbody>
</table>

10. I feel my son/daughter has a better attitude to mathematics as a result of attending the maths camp.

<table>
<thead>
<tr>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
<th>DON'T AGREE</th>
<th>DISAGREE</th>
<th>STRONGLY DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>41%</td>
<td>13%</td>
<td>34%</td>
<td>3%</td>
</tr>
</tbody>
</table>
# MATHS EXPLORATIONS CAMP EVALUATION

**Part 1. Please circle your choice of answer.**

1. I enjoyed the mathematics activities I did at camp.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>19%</td>
<td>19%</td>
<td>46%</td>
<td>14%</td>
</tr>
</tbody>
</table>

2. I enjoyed the non mathematics activities I did at camp.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>71%</td>
<td>27%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

3. I enjoyed working cooperatively in groups.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td>35%</td>
<td>29%</td>
<td>6%</td>
<td>6%</td>
</tr>
</tbody>
</table>

4. I learned a lot of mathematics at the camp.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>2%</td>
<td>37%</td>
<td>15%</td>
<td>33%</td>
<td>14%</td>
</tr>
</tbody>
</table>

5. I learned a lot about mathematics at the camp.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>37%</td>
<td>29%</td>
<td>21%</td>
<td>4%</td>
</tr>
</tbody>
</table>

6. Discussing each activity afterwards helped improve my understanding of mathematics.

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Don't Know</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>12%</td>
<td>46%</td>
<td>21%</td>
<td>12%</td>
<td>10%</td>
</tr>
</tbody>
</table>
7. I had a wonderful time at camp.

<table>
<thead>
<tr>
<th>STRONGLY AGREE</th>
<th>AGREE</th>
<th>DON'T KNOW</th>
<th>DISAGREE</th>
<th>STRONGLY DISAGREE</th>
</tr>
</thead>
<tbody>
<tr>
<td>8%</td>
<td>23%</td>
<td>27%</td>
<td>33%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Part 2. Answer the following questions giving as much information as you like.

8. My favourite mathematics activity at the camp was

________________________________________________________________________

________________________________________________________________________

9. Would you like to go to a mathematics camp next year? ____

Why/why not_________________________________________________________________

10. What was the thing (or things) you liked best about the camp?

________________________________________________________________________

________________________________________________________________________

11. What changes would you like to make in order to make the camp better for next year's grade 6 classes?

________________________________________________________________________

________________________________________________________________________
References


