Can the new Quebec science curriculum meet the needs of culturally diverse learners?

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ABSTRACT

Can the New Quebec Science Curriculum Meet the Needs of Culturally Diverse Learners?

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This study takes a close look at one teacher's interpretation of Quebec's new science curriculum in a grade six classroom where the student population is culturally diverse.

Over a period of two months, I conducted classroom observations on a twice-weekly basis. Data were also collected from two interviews and several informal discussions with the teacher. The data depicted several of the teaching methods and strategies that seem effective for multicultural classrooms and portrayed a positive interaction between the students and the teacher. These were coupled with the teacher's personal style that was appropriate for a culturally diverse classroom. These results are discussed in the light of Quebec's new curriculum reform and the existing literature on multiculturalism and are used to portray a picture of multicultural science education.

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Finally, to my precious sons, Ahmad and Louay, always believe in yourselves and be proud of who you are. To you, I dedicate my work.

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INTRODUCTION

> ... A critical science education offers the empowering aspect that students will learn to adapt their local cultures to scientific ways of knowing, believing and valuing, and learn to adapt science to their own cultural ways of knowing, believing and valuing (Cobern, 1998, p. 207).

> ...The official part of a school's curriculum can exercise a decisive influence on the way students choose to construct, alter and develop their world-view (Québec, 2001, p.6).

This study examines how one teacher working in a culturally diverse grade six classroom interprets Quebec's new science curriculum. The purpose of this study is to examine the reform with an eye on its stand on the topic of cultural diversity, to observe first hand the application of some of the teaching strategies that seem to work in a culturally diverse classroom, and to shed some light on the problems teachers might face in the process.

Three realities provide the framework of this study. First, schools, like other social institutions, reflect the social composition as well as the dominant ideology and goals of the society. In general, student populations are becoming increasingly culturally diverse, bringing into the classroom a wide variety of world views, styles of interacting with adults and peers, attitudes towards school achievement, and the like. From this diversity stems the need for an education that

breeds cultural awareness and responds to the different needs of a mixed student population.

Second, in Quebec's schools today, the educational reform brings major changes in the school curriculum. One of the goals of the new curriculum as stated in the Quebec Education Program (2001) is to encourage students to "interact with an open mind in various contexts, to accept others as they are, to be responsive to others and recognize their interests and needs, to exchange points of view with others, to listen and be open to differences" (p.35). At first glance, these goals seem to acknowledge the need for an education that is adapted to a diverse student population.

Third, the existing literature acknowledges a cultural dimension to science education. Science education is discussed in terms of its potential to be multicultural, i.e. to be able to equally address students coming from different cultural backgrounds who are living different cultural realities, and to offer methods, strategies and approaches adapted to their learning styles while valorizing their own learning experiences. Science education is also discussed in terms of the critical dimension it ought to develop and sustain. A critical science education is an education that promotes, through critical pedagogy, questioning and analysis, for example, of innovations in science and technology and policy decisions regarding application of science.

After review of literature on curriculum reform in particular and on multicultural education in general, I realized that, on the one hand, the reform is still young and so is the literature about it. On the other hand, the relation between cultural diversity and science education is not yet explored enough in terms of its application in the classroom, as suggested by the limited literature on the topic. Thus, I came to the conviction that we need practical studies that can help us understand what is really happening inside our classrooms today, studies that will attempt to bridge the gap between theoretical knowledge and real practice.

Before discussing my study, I will start by exploring the different concepts that set the ground for it, such as cultural diversity, multiculturalism and critical pedagogy. I will discuss them in relation to education in general and to science education in particular. I will then look at the reform in the light of these concepts. Although this study discusses one specific situation and does not provide grounds for generalizing, it gives us insight about what is going on in some schools and about some of the practices that seem to work in a culturally diverse setting. The issues raised leave tremendous scope for further reflection and future studies.

CHAPTER ONE

Multiculturalism- an overview

In this chapter, I will look at cultural diversity and education in Canada in general and in Quebec in particular from a historical perspective. I will then draw the connection between this diversity and science education. After clarifying where Canada and Quebec stand on the issue of multicultural education, I will discuss in more detail multiculturalism itself and what it is expected to achieve in education as well as the problems related to it. Finally, in the last section, I will discuss the relationship between multiculturalism, critical pedagogy and science education.

Cultural diversity and the Canadian society

Canada has always been culturally diverse. However, the significant numbers of immigrants during the twentieth century brought to the fore a number of questions about the identity that Canada will have. Historically, different positions dominated the public mind. In Quebec, a province immersed in its own identity crisis, this problem took a different turn. Today, far from being resolved, the multicultural dilemma is as explicit in the educational system as it is in society in general. If Quebec is to remain internationally competitive, science and technology should be at the heart of societal change. There are two alternatives for science education. It can become the education of an elite and leave behind an important section of society that is not able to relate to science education, or it can

become multicultural and facilitate the contribution of every member of society regardless of his social status, race or ethnicity. One thing is for sure: change is inevitable.

At different times in Canadian history, different approaches and official positions about immigrants were publicly adopted. On one end of the spectrum, there was the belief that the best way to accommodate immigrants is to accelerate their assimilation into the host culture by acquiring the language and customs of the host country, regardless of their own heritage. On the other end, there was the belief that it is the right of immigrants to have the choice of keeping their native and ethnic heritage, and that it would not only be better for them but for the host country as well.

Prime Minister Mackenzie King, in a speech in the House of Commons on May 1, 1947, expressed his position by stating " the people of Canada do not wish, as a result of mass immigration, to make a fundamental alteration in the character of our population" (Samuda, 1983, p.187). Many immigrant intellectuals agreed that acculturation is a prerequisite for social participation and not a form of oppression. According to Ijaz & Ijaz (1983), new immigrants

> ...often tend to eagerly comply with the norms of the host culture in order to participate in its social and economic trappings. Many new immigrants consider prejudice, social abuse, and even exploitation by members of the host culture as inevitable consequences of immigration and tacitly accept them in the hope for a better future (p. 259).

Public attitudes and policies on assimilation influenced the public school and shaped its role. This role was to integrate students into the Canadian culture as it was considered the only way for them to function more successfully within it. In Quebec, the Church controlled the educational system of the French-Canadians. This system "was not producing sufficient numbers of qualified students for either entry into the work force or advancement in post-secondary studies" (Behiels,1985, p.164). This was slowing the development of French-Canadian society in Quebec and many francophones began worrying about losing their cultural identity and economic superiority in North America. Many Quebeckers believed that their children required an educational system that was accessible to all and provided sufficient knowledge to allow Quebecois society to prosper within the modern urban-industrial economy. In 1959, one year before gaining the premiership of Quebec, Jean Lesage, leader of the Quebec Liberal Party, published a book entitled "Lesage s'engage", in which he outlined many of his party's plans and policies for reform. On the issue of education, Lesage stated that it was "the first problem which we must solve" (p.19). Lesage continued to describe his stance on education by writing:

> Pour bien remplir ses devoirs de citoyen dans une société fortement évoluée, l'éducation et l'instruction sont devenues plus nécessaires que jamais. Pour bien gagner sa vie dans un monde sans cesse soumis au progrès de la science, et la technique et de l'industrialisation, l'éducation et l'instruction s'avèrent chaque jour plus indispensables que la veille (p.18).

Between 1960 and 1966, many and far reaching changes took place in Quebec in what is known as the Quiet Revolution. The period was marked by intense social

change and a series of political re-arrangements that reshaped Quebec and allowed it to enter the modern era.

The 60s was not a period of change in Quebec alone. In the United States, it was the rise of racial pride and ethnic awareness with the Civil Rights movement. The current of de-colonization and the movement for civil rights made social and national inequities increasingly difficult to accept. Assimilation and the melting pot theory started to be seen as a weapon aiming to destroy the cultures of ethnic groups and deprive them of political power and personal effectiveness. It was also seen "as a racist ideology to justify damaging school and societal practices that victimized minority children" (Banks, 1983, p.284).

In Canada, liberal and leftist forces everywhere questioned the social order that had been accepted for so long. The objectives were democratization of the political system and of the educational network, equal and adequate access for all social classes and regions to educational and social services. Quebec was no different. Lesage's first step in reorganizing education came in 1961 when he passed a series of laws collectively referred to as the Grande Charte de l'Education (Magna Charta of Education).

In May 1961, The Royal Commission of Inquiry on Education in the Province of Quebec, under the direction of Alphonse-Marie Parent, was created. The Parent Commission was implemented to report on the problems of education in Quebec

and recommend possible solutions. In 1963, the Parent Commission published its first report. The Commission then printed its four subsequent volumes in 1964, completing its in-depth study of Quebec's education system. The Parent Commission especially recommended that new high school curricula include the increased teaching of mathematics, chemistry, physics, biology, geography, history, and languages. It was felt that these subjects, promoted by the Ministère de l'Éducation du Québec (MEQ), allowed Quebec society to regenerate and instigated a more competitive spirit among young adults. This was the essential first step in bringing Quebec into a more global situation. The next step was the ratification of Bill 60 in May 1964: the first Department of Education in Quebec, in nearly one hundred years, became official. The Quiet Revolution's educational reforms expressed the desire of many French Quebeckers to protect and promote French-Canadian ideologies within Quebec classrooms by teaching "cultural aspects to adolescents so that they would retain and transmit their heritage in the future" (Turcotte, 1997, p.30).

With the rise of the Quebecois' cultural identity and the troubled English-French relations in Canada, the government of Mr. Lester Pearson established, in 1963, a Royal Commission on Bilingualism and Biculturalism (RCBB) to study and recommend solutions to these problems. In 1969, the Bicultural and Bilingual Act became a law. However, as the RCBB held hearings across Canada, the commissioners heard about more than just the English and French relations. Ethnic group spokespersons everywhere argued that the old policy of assimilation

was both unjust and unfair and overall a failure. The ethnic group representatives urged that a new model of citizen participation in a larger society be adopted- one that addressed all the ethnic groups that were part of Canada. They argued that ethnicity did not determine Canadian identity but rather the identity of the people did. They even offered a blueprint for a Canadian identity based on the public acceptance of difference and support of cultural pluralism. Unlike the melting pot model of the United States, they preferred the idea of a 'cultural mosaic'-unique parts fitting together into a unified whole. The Royal Commission presented the government with this idea and recommendations. The first multicultural policy in Canada, "multiculturalism within a bilingual framework", was accepted in 1971 while Pierre Elliot Trudeau was Prime Minister. Multiculturalism affirmed English and French as the two official languages of Canada and ethnic pluralism was declared to be a positive feature of Canadian society worthy of preservation and development. It encouraged gaining an understanding of people from all cultures, despite language, religious beliefs, political and social views, or national origins. It acknowledged there are many ways in which the world can be viewed and lived in and promoted respect for people's distinct cultural identity, while ensuring that common Canadian values are upheld. In 1982, the multicultural policy became a law and later in 1988 Bill-C-93 was passed as the Multicultural Act.

While many provinces followed the federal lead by introducing multiculturalism policies in their areas of authority, Quebec rejected it in favor of intercultural

education. The modified version of multiculturalism adopted by the Quebec government in 1978 under the name "la politique Québécoise du développement culturel", "stressed both the value of cultural diversity and the necessity of sharing cultural differences in a common society through a common medium: the French language" (McAndrew, 1995, p.173). In other aspects, Quebec policy is consistent with the Canadian Multiculturalism act. They both promote equality, respect, support of cultural diversity, and encouraging communication between groups.

Today, the terms used to describe the dynamics within the Canadian and Quebecois social composition are as diverse as society itself. We hear about cultural integration, cultural pluralism, structural pluralism and multiculturalism. Regardless of the terminology used, the reality is that we need to find a balance between unity, diversity and equality and to transmit this balance through a curriculum that attends to the different needs of different students. In the past decade, surveys indicated that the number of scientists, engineers and technologists graduating in Canada is not sufficient to keep Canada "industrially competitive" (Ghosh, 1995, p.12). Thus, logically, the curriculum should encourage as many students as possible to engage in science. In Quebec in particular, can the new science curriculum meet the needs of culturally diverse learners and ensure, regardless of their cultural background, their full commitment to the culture of science? Is it truly inclusive?

Challenges to multicultural education

Since its birth, many challenges faced the multiculturalism concept. One of these challenges is that multiple interpretations of the term itself are possible. In the considerable literature written on multiculturalism over the years, the meanings attributed to it changed from paper to paper, and sometimes even within the same paper, depending on the writer's perspective and his own implicit or explicit intentions. " In some cases, [it] has become nothing more than a cliché or political slogan" (Kach & Defaveri, 1987, p.229).

Multiculturalism and cultural pluralism are often used synonymously, especially when they are used as descriptive terms. They illustrate the condition of society that includes several different cultural groups and where members of these groups interact in a large number of social institutions, contexts and activities. Nevertheless, these terms also represent a social ideal to which a culturally diverse society may conform to a greater or lesser degree. Therefore, although the United States and Canada describe their societies as multicultural, that does not imply that they are multicultural in the same way or to the same degree. According to Appleton (1983), cultural pluralism generally implies diversity, some minimal interaction between and among groups, relative parity and equality between and among the groups, as well as a perceived value for the continuance of diversity. While the first two criteria are merely descriptive of a society's cultural diversity, the last two are "criteria for the degree to which a particular

society is pluralistic" (Appleton, 1983, p.23). Other literature refers to multiculturalism as a process of education affiliated to cultural pluralism or as a "pedagogy that respects value differences without dissolving into relativism, that forms character and virtue without hardening into absolutism, that assures cohesiveness without encouraging conformity, and that promotes justice without becoming uncaring" (Power 1992, p.13).

Two of the major goals of multicultural education are to protect students from the violation of their ethnic cultures and to defend them against self-alienation. Another goal, as stated by Banks (1983) is to help students "develop cross-cultural competency, which consists of the attitudes, knowledge, skills, and abilities needed to function within their own ethnic culture, the universal American [or Canadian] culture, and within and across other ethnic cultures both in this nation and in other societies" (p. 287). Although one of the aims of multiculturalism is to allow minorities to have their proper identity, it is not uncommon to read that the implicit aim is just the opposite. Bullivant expresses this position in his book "The Pluralist Dilemma in Education". He portrays multiculturalism as a manipulative device used to control ethnic groups. On the same note, it was argued that the policies of multiculturalism in B.C. and Ontario "are geared essentially to integration of newcomers, and not to ethnic perpetuation" (Kach & Defavri, 1987, p.236).

If multiculturalism is to be the basis for today's pluralistic society, every individual, regardless of his ethnic roots, should have the same rights and duties as the other members without, however, violating his uniqueness and his freedom of choice. Diversity should be valued and respected beyond mere political correctness. It is a fact of our society that the socio-cultural environments of students include their own ethnic sub-society, the national society as well as other ethnic sub-societies. Multicultural education faces the challenge to reflect this reality.

Multicultural education today is at a speculative stage. There is no guideline based on documented research, observation and explanation of successful practice in the classroom. As a result, while numerous classrooms are witnesses of successful practices in multicultural education, many teachers are still experimenting with their students to find out what works best and what doesn't work in a culturally diverse classroom. Many questions about multicultural education remain without a definitive or clear answer. For example, the assimilationists argue that dual cultural identity does not exist and that ethnic attachments become dissolved then disappear as the new cultural identity replaces the ethnic identity. However, in the literature on multiculturalism, one finds many arguments that the ability of individuals to function effectively within their own ethnic communities as well as within the national culture proves their ability to have and maintain multiple identities. These individuals can be well adjusted and can represent both of their cultural backgrounds without cultural conflict. It is also

argued that, in the domain of cognitive flexibility, bilingual children have a cognitive advantage over monolingual children (Lambert & Tucker, 1972). The possession of a dual heritage adds to their potential value to the nation and to their chances of adjustment.

A challenge of high priority to multicultural education is prejudice and racism. Hilliard (1983) attributes the existence of prejudices to "our national history, which includes slavery and our close identification with the thinking of former colonial powers about formerly colonized people" (p.50). Categorizing some groups of people as 'uncivilized' or 'primitive', equating high technology with the Western technology, labeling some cultures as 'cognitively deficient or underdeveloped' are but few examples of these prejudices.

The deficiency model is adopted by some teachers who believe that culturally diverse children come from culturally deficient communities and environments that do not properly prepare them for learning. Some teachers sometimes assume that these students and their parents do not care whether they do well in school and that these students are not motivated to learn. The cultural deficit model also assumes that schools should help students assimilate to mainstream culture, including the "culture of science". Some educators, in an attempt to rectify the situation, identify culturally diverse children who are interested in science and provide them with some tutoring to correct their deficiencies. "For a very long time science educators have been asking the question, What's wrong with the

children? Perhaps they should have been asking, What's wrong with the system?" (Barba, p.11)

The other example of prejudice that Hilliard used - equating high technology with western technology- is expressed in the science curriculum through the use of Eurocentric/androcentric instructional models. These instructional models focus on transmitting to the students the values and beliefs of white-male Europeans and their descendants and assume that the students will have no problem assimilating to this kind of instruction. Hirano (1997) introduces his work on cultural pluralism by saying,

> I am also writing this in the hope that many scientists come to realize that the cultural universalism, prevalent in scientific studies for nearly two centuries, is not the only choice even in the European intellectual tradition, nor is it without possible fallacy.

During the last couple of centuries, science and technology were considered to be a distinct culture that is not affected by other cultures. Advocates of the cultural universalism of science insist that there cannot be more than one identity to science. There is the scientific truth and then there is fiction and popular misconceptions. Indigenous knowledge is included in the latter. According to Peacock,

> Teachers in primary schools [...] are likely to adopt the dominant world outlook on science as what white, western scientists do: the view that science has always been 'out there' waiting to be discovered, and is hence no different whatever culture you belong to. Water always flows downhill, crop always die without water... where's the multicultural dimension? (p.4).

Since cultural universalism of science ignores the socio-cultural aspect of science and science education, the children who do not share the same values, attitudes and believes as those taught in school might be reluctant to participate in science.

Cultural pluralism calls for the recognition of cultural identity to science. "The science is as dependent on culture as art, music and poetry" (Peacock, p.4). Science is not necessarily what one group of people believe it to be, nor it is primitive if it is different. However, the debate on the identity of science and technology is beyond the scope of this paper. I intend to focus only on the cultural pluralism in science education and not in science itself. Regardless of whether we believe in a universal science or not, we cannot deny the fact that education is closely related to culture and that in a multicultural world, science education cannot be mono-cultural.

In order to avoid prejudice and discrimination, some teachers tend to treat all students 'alike'. This does not answer any particular needs of students from different cultural backgrounds. The teacher should be fully aware of the linguistic and cultural background of the student and needs to deal with him/her accordingly. However, this does not mean that culturally diverse students should be taught with a different pedagogical approach. The cognitive structure of people is global and does not vary with culture. The awareness should be in relating education to the history and culture of the students, and in the understanding of

behavioral not cognitive differences. If a pedagogical approach fails, "the educator must analyze pedagogy, not the learner or the culture" (Hilliard, 1983, p.59).

Educators in general and science educators in particular have a major role to play in order to change these misconceptions. Prior to attempting to change the curriculum, educators should look back at their own hidden assumptions and prejudices as well as those of the students they are dealing with and start by assuming some collective responsibility in making positive changes in interethnic attitudes. In some cases, the educators' prejudice can be implicitly manifest in the hidden curriculum which portrays their believes about alleged educational potential of some minority students and their future achievement resulting in a significant influence on the values taught to students. Consequently, many minority students are often undereducated or miseducated and the cultural or racial heritage of many minorities is despised or unaccepted by their teachers or by other students. Unfortunately, negative ethnic attitudes often remain unrecognized and therefore not dealt with until they are exposed through open – and often violent- expression of hate and racial discrimination as we see in regular reports in the press. Many efforts to teach multiculturalism are observed in schools. Nevertheless, they are often successful attempts by individual teachers and are not systematically backed up by school boards.

Cultural reproduction represents yet another challenge to multicultural education. Cultural capital, which can also be described as cultural competence, stems from the family but extends and grows by acquisition. It combines "the prestige of innate property with the merits of acquisition" (Bourdieu, 1973, p.245). This cultural capital, associated with middle class values, is also most important when schooling is the issue because it provides a predisposition to academic achievement. Middle class children arrive at school equipped with this cultural package. The larger the cultural capital, the more head start the child has over children with lesser capital. This cultural package, however, is not dealt with as a factor for success. Schools are portrayed as the land of equal opportunities. They present the academic inequalities between students as ineludible necessities born of the intelligence-or talent-, effort, and desire of individuals. Cultural capital, thus, functions as a major factor in class definition as well as in the conservation of social stratification by being converted into academic qualifications. Ideally, education is a means for children to reach a position in society corresponding to their abilities and motivation and not to their socio-economic status or place of birth. To reach this ideal, advocates of multiculturalism call for a break in the cycle that reproduces generation after generation, and through the school, among other institutions, the existing social, ethnic and racial inequalities.

Testing is also unsettled area to be dealt with. Standardized achievement or intelligence tests are constructed using the norms of the white middle class individuals. They are mono-cultural, "ethnocentric and do not sufficiently

embrace the social and cultural environments of minorities" (Samuda, 1983, p.175). Although they are considerably less used today, these tests are not completely abolished. In the cases they are used, they lead to labeling and grouping that make the job of the teacher easier by providing her/him with a rather homogenous class, and act negatively for minorities. It often implies the placement of minority students in Special Education classes, thus "tending to perpetuate the attitude that if a student is different (culturally), he is therefore academically inferior" (Samuda, 1983, p.193). It is very disappointing to know that, even today, some educators interpret the performance of ethnic minority immigrant students on such tests as a representation of cultural deficits.

One obvious difficulty regarding the implementation of multicultural education is that of jurisdiction. Multiculturalism was introduced as a federal policy; however, education is a provincial affair. Those who proposed multiculturalism are not in charge of educational matters, and those who are in charge of implementing pedagogical changes are not clear about multiculturalism. Two decades ago, there was "little or no cooperation even between the large boards where ethnic minority immigrant students form a significant proportion of the population" (Samuda, 1983, p.195). The situation does not seem very different today. The great shift in attitudes that multiculturalism is supposed to achieve can happen in school and society only if there are cooperative efforts. Effort should start at the level of the average citizen, encompass teachers and school boards and include "planning at

the federal-provincial level, at the provincial-municipal level, and at the community level" (Samuda, 1983, p.195).

From the implementation of multiculturalism stems yet another conflict, the legality conflict. The First annual Report of the Consultative Council on Multiculturalism stated that the government of Canada will support all of Canada's cultures and will assist those groups that have expressed the desire to continue to develop in the Canadian context. The problem arises when an identifiable culture expects to perpetuate itself with full legal protection although some expressions of ethnic identity are morally or legally unacceptable in Canada as in the story of the Indian Sikh student who was not allowed to wear his "kirpan"- a ceremonial knife - to school regardless of the religious reasons behind it. Not long ago, a Canadian Moslem girl was suspended from a public school because she wore the "hijab" (head scarf). Other cultural expressions may even contradict the Charter of Rights itself. Teachers will be frequently faced with the dilemma: "which expressions of ethnic identity it is appropriate for them to reinforce, which to ignore, and which to discourage" (Kach & Defaveri, 1987, p. 232).

In order to face all the challenges that stand in the way of multicultural education, a clear goal must be defined. Multicultural education is defined by some as a pedagogy that possesses multicultural characteristics. Others define it in terms of the maturity and awareness on the side of parents and teachers that encourages

these characteristics. This maturity would express itself in guidance and encouragement in discussions with students, and in promoting cooperative activities and relations among them. Banks distinguishes four ways of "integrating cultural content [or knowledge and activity dealing with the other culture] into the school and university curriculum" (Banks 1994, 24). Of these the "contributions approach" that consists on focusing on great individuals, festivals, and other discrete cultural elements, and the "additive approach" that means adding cultural content, concepts and themes to the curriculum "without changing its basic [actually colonial] structure, purposes and characteristics" (Banks 1994, p. 25). These two approaches, according to Banks, tend to engage the child or youth only with discrete elements of the other culture and from an external point of view. Historical events, social patterns and cultural traits are understood at a verbal, semantic level, viewed from the outside with little feeling for the actualities of the experience of a member of that culture. The third approach is the "transformative approach" that "enables students to view concepts, issues, themes and problems from different points of view" (Banks, 1994, p.26). Here students can "read and listen to the voices of the victors and the vanquished," and "are helped to analyze the teacher's perspective on events and situations and are given the opportunity to formulate and justify their own versions" of these (Banks, 1994, p.26). In these kinds of activities the student has the possibility to subjectively understand the experience of a member of the other culture in his/her cultural and historical context. This gives the student the possibility to understand that person at a universal human level, and to begin to be able to see and respect

the other culture in its own right as another way of channeling an individual's feelings and life.

Despite the number of challenges affiliated with multiculturalism, we cannot deny the need for changes in the social system and in people's attitudes "to bring about not only tolerance toward and acceptance of all races and cultures, but also the recognition that the diversity of cultures constitutes the very essence of the human experience" (Ijaz & Ijaz, 1983, p.258). The realization of multiculturalism is the responsibility of both minorities-if they want to ensure the survival of their cultural and linguistic heritage- and majority- if they want to preserve diversity. This is where the role of transformative or critical pedagogy prevails and where science education in particular has a contribution to make.

Multiculturalism and critical pedagogy

With a spectrum of challenges as wide as that discussed earlier, we certainly need a wide spectrum of change. This will include, without being restricted to, changes in teacher training, curriculum, teaching practices and assessment procedures. To be able to deal with the change, multiculturalism should work hand in hand with the development of a culturally sensitive pedagogy dominated by a developed critical consciousness. Multiculturalism and critical consciousness can be considered two faces of the same coin. Critical consciousness is the building block of the pedagogy of liberation that was discussed and promoted by many

thinkers and educators such as Freire, McLaren and Giroux among others. It focuses on action toward change. "Rather than teaching loyalty and commitment to the status quo, schools could teach sincere questioning and critical analysis" (Young, 1987, p.379). These educational theorists call for a radical pedagogy that provides the way for social change and views schools "not simply as an arena of indoctrination or socialization or a site of instruction, but also as a cultural terrain that promotes student empowerment and self-transformation" (McLaren, 1998, p.167) and as sites of liberation, not domination. They agree that education should not and, as a matter of fact, cannot be depoliticized because politics reside in every aspect of teaching or learning. Through a critical attitude toward the political side of education, "the oppressed unveil the world of oppression and through the praxis commit themselves to its transformation" (Freire, 1970, p.161).

Critical pedagogy calls for collective action to build a multicultural society in which justice and empowerment are the groundwork. Empowerment is the process by which students learn to question and selectively appropriate those aspects of the dominant culture that will provide them with the basis for defining and transforming, rather than merely serving, the wider society. Students should have a participatory role in the learning process and should engage in a mutual dialogue that can enable them to relate to these concepts and ideas, to learn and to teach at the same time. Critical theorists stress the importance of developing alternative teaching practices capable of empowering the students both inside and

outside the school. For empowerment to be achieved, students and teachers must renounce their submissive attitude toward learning and teaching.

In the current educational system, some students assist the school in social reproduction by resisting learning as a way of resisting oppression. The remedy to this situation can be achieved by starting to make learning relevant and situated- by relating the material to the students' condition. If we are to move beyond theory, we should start by realizing how individual is each situation. Even within the same system, homogeneity does not exist. The situation in each school and even in each classroom is as unique as the fingerprint of the students in that class. No rigid pedagogy can be implemented because that would be exchanging one kind of domination with another. Although the development of a critical pedagogy is not just possible, but a must, it should act as no more than a guideline for teachers who, then, mold it in accordance with the needs of their students. "Teachers need to find new ways to get involved with the communities in which they live and teach, to make a difference... to think globally and act locally" (Giroux, 1991, p.140).

Finally, a radical critical pedagogy is still under development. It will actually be constantly under development to meet adequately the ever-changing needs of society. However, if we are, as educators and students alike, to make changes in our society, we have to open our eyes to reality, and extend education beyond the confined walls of a classroom into the larger society. Above all, we must believe

in our individual importance and our collective power to make a difference in our educational and social structure. In a time when a larger number of people are realizing that the world is but one small village where the actions of each individual can trigger reactions that can affect everyone, we should start assuming our responsibilities and set aside our differences. As educated people, we cannot be excused anymore for being shortsighted and being selfish in our concerns. We should spare no effort and no human or material resource to educate people for a functional version of multiculturalism. After all, diversity will not go away; it is a fact and reality of global existence. As we are part of the system, if we have the will, we can find the way to limit our problems, overcome our weaknesses and provide our children with a better place to live. With these intentions in mind, I conducted my study.

CHAPTER TWO

Quebec's Curriculum Reform

> As products of a society at a given point in history, schools transmit the beliefs, values and knowledges of that society at that time, both implicitly and explicitly (Québec, p.4).

Background of the reform

In order to understand the latest wave of curriculum reform in Quebec we need to understand the previous changes that led us here and we need to keep in mind that this wave of change is not only local, but constitutes an echo to a world-wide curriculum update in many countries such as Australia, the United States and other Canadian provinces. This global change logically follows the rapid evolution of technology and the needs of the global market. This evolution changed many basic concepts such as the literacy concept. Literacy cannot be defined any more in terms of reading and writing skills but can be better described as techno-literacy. As Aikenhead explains, "in a society increasingly shaped by science and technology, ignorance or fear of science and technology can enslave a citizen into a 20th century serfdom [...] Techno-peasants are outsiders in their own society" (Aikenhead, p.130). Schools, like other social institutions, reflect that society's dominant ideologies and goals. Thus, as the needs, ideologies, and values of Quebec society evolved, so did the curriculum.

There have been three major waves of reform in Quebec. In the 1960s, following the recommendations of the "Royal Commission of Inquiry on Education", education reform changed control from the hands of the Church to the hands of the State. This top-down Quiet Revolution came as a result of local changes in the population and global changes in the role of the Church, as discussed earlier. The focal point of this wave of reform was expansion and accessibility of the education system.

In the 1970s and 1980s, Quebec's social composition was altered by the large number of immigrants. Until 1977 more than 80% of Quebec's students of ethnic origin did not attend French schools. This pattern which was perceived as a threat to the cultural and linguistic heritage of Quebec was reversed with Bill 101 which established French as the official language of schooling in Quebec with an exception made for children whose parents had been educated in English schools in Quebec or Canada. These bottom-up or back-to-basics reforms had curriculum and school organization as their focal point. The main modification was the installation of "régimes pédagogiques" or regulation of curriculum by the government.

In 1987, the "Conseil Superieur de l'Education" published a series of reports emphasizing the need to deal with the growing ethnic population in Quebec's school system. This call for restructuring was a tentative reform that was interrupted by a change in government. The most recent wave of reform started

with the document of the Estates General on education in 1995. In response to recommendations made by the Commission for the Estates General, the guidelines for the most recent set of Quebec education reforms were first published in October 1996 as "A New Direction for Success".

As mentioned earlier, reform waves in many countries worldwide were taking place –namely Australia, the United States as well as several Canadian provinces- in an attempt to keep up with a rapidly changing global economy. Similarly, in Quebec, the education system of the late 1980s and early 1990s was no longer adequately addressing the needs of students to adapt to the world market on one hand and to the local changes in Quebec's ethnographic composition on the other hand, thus the need for the new curriculum reform.

A general trend of this current reform movement both globally and in Quebec is to focus on three major areas: centralization of curriculum, an increase of student and school assessment and the decentralization of management to individual schools. The process for implementing this plan of action has begun at the elementary level as well as the college level and will proceed over the next several years to include a major restructuring of secondary schools. Moreover, recommendations for restructuring at the partially subsidized university level will also be suggested.

School and diversity in the new curriculum

According to some, our situation is close to what Barba (1995) states about the U.S: "We are becoming a nation of racial and ethnic 'unmeltables', a nation in which 'minorities' are becoming the majority population" (p.5). Quebec's culture, in the fullest and richest meaning of that word, is becoming pluralistic, as are the cultures of a growing number of societies. The school can no longer be considered a homogenous milieu. Therefore, "one of the major challenges of the reform of education in Quebec is to move away from the 'one-size-fits-all' school of the last 20 years" (Mcgill, p.249). This is well known to those who have been calling upon schools and educators to become more sensitive to the diversity of situations, students' needs and aspirations.

I discussed earlier the importance to address education from a multicultural perspective and the magnitude of the educational challenges this implies. In this section, I consider the new Quebec Education Program in terms of its potential to bring about a mind-set that is inclusive, socially constructive, critical and representative of the wide range of perspectives that one finds in this society. In order to rise to the challenge of an inclusive and critical education, the curriculum goals should be aligned with the major aims of multicultural education. The education that the reform promotes should be able to deal practically with, at least, some of the challenges that face multicultural education. In the words of the Quebec education program (2001):

> schools have a role to play in helping students, through various experiences, to define themselves as individuals, to recognize their cultural identity and to be receptive to other cultures...broadening their horizons...encouraging them to take positions on major social issues (p.32).

By developing awareness, such an education encourages children to take a thoughtful and active part in their future. Furthermore, the new curriculum reform calls for an education that promotes acceptance and interaction. The goals of the new curriculum are stated in terms of encouraging students to

> interact with an open mind in various contexts... to accept others as they are... to be responsive to others and recognize their interests and needs... to exchange points of view with others, to listen and be open to differences" (Quebec, p. 35).

Although the Quebec's curriculum encourages such positive attitudes as "to respect others and accept their differences, to be receptive to pluralism, to maintain egalitarian relationships with others and to reject all forms of exclusion" (p.50), no practical dimension to such statements is found in the actual curriculum.

In addition to the limited practical aspect, there are many statements throughout the program that express a contradiction in its orientation. On one side is support of pluralism and on the other is integration. On one hand, the new curriculum is described as "...open to the world. [...] to meet the challenges of a pluralistic society that welcomes diversity" (p. 2). On the other hand, the students are

encouraged to become "familiar with their culture, pursue understanding of the world and the meaning of life and develop new ways of adapting to society" (p. 2, emphasis added). This adaptation is considered one of the school's responsibilities:

> Although it is undeniable that children bring to school a predisposition to interpret the world in certain ways, school can have a major influence on their world-view, mainly because they attend school during the period in their lives when their ideas are most flexible (Quebec, p.6).

Constructing a world-view is the focal point of the whole program. This 'view' that the school is supposed to shape is not clearly described in the curriculum. However, its development depends in part on constructing identity and exercising critical judgment. According to the program, this is achieved by "... [encouraging] students to make connections between what they learn at school and in their everyday lives...The broad areas of learning enable students to relate different areas of learning and to look critically at their personal, social and cultural environment" (p.6). This is extremely important for the development of the person and for education to be relevant. However, if what students learn at school does not in reality take into consideration what students live outside school then alienation is likely to occur- a contradiction of the aims of pluralistic education. The student should feel that the reality and the experiences he/she lives outside the school are valued by the teachers and by the school. Teachers must therefore be trained to handle these situations.

The Quebec's program reminds us repeatedly about the importance of adapting to society and helping students through this process of adaptation. We cannot deny the importance of adapting to the society we live in, however, we cannot think locally and expect the new generation to be able to function globally. This is why the development of cross-cultural competencies is an important part of multicultural education. In the program, however, it is limited to promoting interaction 'with an open mind'.

Henchey (1999) addresses this absence of an explicit discussion of pluralism or cross-cultural communication in the program even before the final document was published,

> There is little explicit recognition of the pluralism in Quebec society (except implicitly as a problem), especially that rooted in the culture of the Aboriginal peoples, the cultural and ethnic communities, and the English-language cultural and educational tradition of Quebec. There is little acknowledgment of the contribution these communities can make to the overall vision and narrative of the curriculum nor the way in which the substance and tone of the curriculum should be changed to meet their needs. Issues such as ":citizenship education", "the cultural content of curriculum" and "intercultural education, citizenship and international understanding" are not given very serious analysis in the official documents (p.238).

An important feature of pluralistic education is the use of science education as a vehicle for multiculturalism because its principles are very similar to the rules that govern scientific thinking. The development of both –science education and multicultural education- depend to a great extent on observation, interpretation of

evidence, description, communication of ideas and group effort to achieve progress. Unfortunately, as mentioned earlier, existing literature provides us with evidence of unawareness on the part of some teachers of the existence of a pluralistic dimension to science education. The old curriculum did not provide assistance to teachers in approaching elementary science from a pluralistic perspective. The new curriculum does not either. There is clear evidence throughout the Quebec's program about looking at science education from a culture-independent point of view. It aims at training students to "become familiar with specific ways of observing the phenomena around us" (p.160, emphasis added) "... the students become familiar with the types of reasoning that make it possible to deal with scientific and technological problems" (p.161, emphasis added). The program does not address at all the possibility of having students come to school with different ways of observing and different types of reasoning that are, nevertheless, of equal value as those eurocentric 'ways' taught in the classroom.

In theory, the importance of cultural and historical references is backed up in the Quebec's program in statements such as "... the learnings will reflect contemporary reality in both form and content, but they will be more meaningful and deeper if their cultural references are familiar and they are placed in a historical perspective" (p.4). This statement does not necessarily imply pluralism: if the reality reflected is local then the cultural references discussed are those of

Quebec and the historical perspective is that of Quebec. This limited cultural reference defeats the core purpose of multicultural education.

Quebec's education program warns teachers repeatedly about "the negative consequences of stereotypes/discrimination and exclusion" (p. 50). In an effort to "prevent exclusion, which jeopardizes the future of too many young people" (p.3), the program sets a goal to include culturally diverse children in the culture of Quebec in general and the culture of science in particular,

> In a pluralistic society such as ours, schools must act as agents of social cohesion...This means that they must transmit the heritage of shared knowledge, promote the fundamental values of democracy (p. 3).
>
> Throughout their schooling, the students become more proficient at using the languages and types of representations used in science [...] to better organize and express their thoughts (p.170).

It is very critical here to make sure that teachers have the cultural awareness needed to understand the pluralistic dimension of science and to avoid falling into the trap of the cultural deficit model. Culturally diverse children often encounter problems learning science and understanding the concepts because they could not make the link with their own cultural baggage.

Not all children construct knowledge in the same way. Knowledge construction is shaped to a certain extent by culture. Culture also affects the way children respond or interact with teachers. Barba uses the example of Native American children who are raised to divert their gaze when they speak to a senior. This

behavior is a mark of respect in their culture but can be interpreted by some teachers in our society as inattention or even impoliteness.

> Culturally diverse learners sometimes find that their ways of thinking, knowing, and interacting are unacceptable in the elementary science classroom. For many, the rules of social interaction and the patterns of learning acquired at home become impediments as they struggle to make sense of school learning (Barba, p.14).

Most children who experience this cultural conflict or cultural discontinuity tend to lose trust in the teacher, resist learning and chose silence. (Lipka, 1991)

In our classrooms today, cultural diversity is a reality we have to deal with. However, our curriculum encourages teachers to take action but does not provide them with the tools to do so, nor does it implement ways to evaluate whether action is actually taking place. The present curriculum is very interesting in that it provides the opportunity for educators to be transformative. However, educators who are not aware of this dimension to education cannot be transformative. Although the new curriculum does not focus on the multicultural aspect of education- it hardly addresses the pluralistic reality of schools- the decentralization of the curriculum bares two possible consequences. It can be a golden opportunity for educators to explore the multicultural dimension of education (be it in a diverse or mono-cultural classroom). It can also completely ignore this multicultural dimension and proceed with the same half-a-century old ideology and methodology that does not want to acknowledge today's world as a different place and that this change is not to be perceived as a threat to Quebec's

culture. The difference in social and ethnic composition between different cities in Quebec is large. The Quebec's new program can be adapted to meet the needs of every teacher and it can be implemented in many different ways. In fact, the present curriculum is so flexible that the ways of applying it can range from merely avoiding racism in the classroom to teaching pluralism. It is up to the school board and the individual teacher to decide the extent to which they are willing to go to teach science from a pluralistic perspective. Henchy (1999) wonders

> how much agreement endures when issues of substance and content arise [and] how much emphasis there should be on cultural implications of science and technology [...] and what value is placed on multiculturalism in Quebec schools especially those outside the Montreal region (p. 235).

Preparing Quebec's new generation for the world cannot disregard the unique social composition of Quebec. Depending on how the reform is implemented, it may mean a fundamental change in the teaching and learning process or it may mean little more than new terminology to describe old practices. However, there is no control over the degree to which the needs of minorities are taken care of within each school. There are no uniform rules that govern the education of minorities. So what does the reform means when multiculturalism is the issue? "...as in any policy option , laws and regulations set up conditions and mechanisms. The actors will determine the outcomes..." (Mcgill,p.252).

CHAPTER THREE

Methodology and data analysis

The classroom and the teacher

This study was carried out in a public elementary inner city school in Montreal. Selection of the school was based mainly on its geographical location in an ethnically diverse neighborhood. Thus, the school population was expected to be culturally diverse as well.

I conducted my research in a grade six (cycle 3) classroom. Its selection was based on the teacher's interest and voluntary willingness to participate in the study. There were twenty-three students in the class. Ten students were of Philippino origin. Among the remaining thirteen students, no more than two students were from the same ethnic background. They spoke French to different degrees, none without a pronounced accent but all seemed to communicate understandably in French. The teacher divided them into five groups. Diversity was a major factor in forming the groups. The teacher tried to avoid clustering of students from the same origin.

Students did not seem to care much about my presence in the classroom. After the teacher briefly introduced me on my first day, they went on with their daily routines. A glance from time to time or a faint smile was the only attention I got

from them. They seemed used to having people observing their class. Over the period of two months that I was visiting their class, the only change in their attitude towards me was an additional occasional "Hello".

The classroom was busy looking. Drawings and charts filled the walls, most of which were prepared by the teacher himself. In one corner of the classroom a teacher's desk and another table were loaded with books, notebooks and the teacher's material. In another corner were two desks with two computers. One was intended for the teacher's use while the other (a much older one) was intended for students. Materials in the classroom were limited to the basics (a couple of pairs of scissors, one glue stick, one scotch tape roll, a stapler, recycled card boards and some coloring pens and pencils...). The desks and chairs had served generations of students before, as did the two couches. One couch served mostly as storage surface for empty cardboard boxes intended for use in projects. A general layout of the classroom is included in Appendix A.

Joe was a young teacher with a degree in history and a teaching diploma. He was the "new" teacher in the school. This was his second year of teaching. Joe was very open to change, new experiences and new ideas. He taught all subjects except for arts and physical education. Although Joe liked to be strict with his timetable and the time allotted for each subject matter, and tried to follow to a great extent his original plans that he prepared the week before, he showed a great degree of flexibility. Sometimes everything went as planned, other times he had to

switch a couple of periods in his lesson plan according to the students' motivation or attention. At other times the schedule had to be abandoned and he would do a last minute change. For example, several times, the school announced a field trip just the day before. In these cases, Joe had to reschedule his planned lessons and activities. He had very good classroom management. Without being severe, he was able to keep order and quiet in his class even during group activities. Students communicated easily with him while being very respectful. Once, a student who was not comfortable in her seat interrupted him to tell him that and he found her a more comfortable seat. Students felt free to move or eat during class time but whenever order was called for, Joe did not have a hard time implementing it. All through the sixteen times that I was present in the class, I did not witness a single behavior that could be interpreted as a lack of respect. Joe's classroom management techniques were simple and effective. He would stop when the students became too active or talkative. He would count to three. That was enough to get back the students attention every time.

Procedures

Originally, I intended this study to be an ethnography. I actually started visiting the class on a three times a week basis during science classes and was planning to do so for as long as required. Soon enough I realized that it was very restraining to the teacher to give me a schedule and to stick to it. He preferred to keep his

schedule flexible. That resulted in my being unable to attend as many classes as I had planned. Therefore, I came to the decision that, in this case, an ethnography was not realistic. Nevertheless, ethnographic methods were used to collect data on which this exploratory case study was based.

I collected data in the classroom during the months of February and March 2003 on a twice a week basis. My role in the classroom was that of a non-participant observer. The exploratory nature of the study required methods that provide access to different aspects of the teaching experience. Therefore, I used multiple methods to collect data. This allowed for data triangulation that increased the rigor of the study. Three aspects of the teaching experience were examined: the teacher's knowledge about the pluralistic dimension to science education, his interactions with the students and his implementation of the science curriculum. In order to examine these points, data were collected from the following sources: a thorough examination of the new Quebec's science curriculum, intense and detailed observation of the classroom focusing on the teacher- student interaction, an ethnographic open-ended interview with the teacher, and, finally, several non-formal discussions and regular electronic correspondence with him.

During classroom observation, detailed reflections on teacher's behavior and attitude were noted; classroom activities were simultaneously recorded in chronological order as well as student-teacher interactions. These sessions were also audiotaped in order to triangulate data from the audiotapes and field notes.

Initial themes and observation of focus points were pre-set from the literature on multicultural science education. However, consistently with the ethnographic design, these themes were modified and new themes emerged during data collection.

One long one-on-one interview was conducted with the teacher, Joe, before the beginning of the observation. In order to explore Joe's perceptions of specific events and interactions observed in the classroom, several informal discussions and electronic correspondence followed each observation session. The interview focused mainly on Joe's prior experience in teaching, his beliefs and his perceptions of his own classroom and of the new science curriculum. A second interview was supposed to be conducted after the two months' observation period. Its focus was to be more about diversity and the science curriculum. This interview was eventually replaced by the informal discussions that served the same purpose.

As copious amount of field notes and other data emerged and I had no help in the analysis of the data, I decided to work with it as different sets: curriculum analysis, field notes, audio material, interview notes, and discussion notes. A crucial set of data originated from extensive content analysis of the Quebec's science curriculum. This early analysis of the reform provided context for reflecting on the teacher's interview and classroom-bared data. A first stage data analysis ran parallel to data collection to describe and develop emerging themes.

Data was divided into a different set of themes: expectations (from teachers, students, parents), appreciation of diversity, assimilation, and practical assistance. Using Word, notes from the initial interview were divided by topic: teacher's background, the reform and cultural diversity in the classroom were the main topics. I reviewed, on weekly basis, audiotapes and field notes as well as discussions with Joe and coded them for recurrent themes or patterns. Notes from classroom observation and audio-tapes were independently divided into three major groups: students-teacher interaction, student-student interaction, teaching methods (group work, individual work, discussions, lecturing, concept mapping...). Discussion notes were integrated to the previous themes and groups. All data were coded for either "my perspective" or "Joe's perspective".

Initially, I attempted to use content analysis and to observe, for example, a count of each type of teaching method. However, it did not take me long to realize that by doing so, I was not able to remain true to what was going on in the classroom. Remaining true to the whole best preserved the essence of the teaching and learning processes. Thus, I decided to use a more holistic approach in analyzing my data. Initial analysis of the teaching activities and different interactions in the class were connected to the actual science curriculum and the recommendations of the reform as well as to the recommendations of different researchers on the topic of multicultural science education. This parallel analysis provided ground for further analysis of the dynamics of Joe's class.

In a second level of analysis, I drew from the interviews to make a connection between Joe's theoretical knowledge of the reform and actual applications in the classroom. To ensure validity, I relied mainly on member checking through an on-going e-mail relationship with Joe. This technique helped me reduce the possibility of making false or misleading interpretations.

Limitations of the study

This study was planned to be an ethnographic study. However, time was a major constraint. I was not able to extend data collection for a longer period of time. I was able, as planned, to communicate with Joe after my data analysis in order to obtain more specific answers or information on issues that arise during data analysis. However, I wanted to discuss again with him his perspective on the reform after he a longer period of time. Unfortunately, Joe was not available for this interview. Another limitation to this study was my being the only researcher. Although I made sure to do member checking with Joe to ensure reliability of my data, the presence of another researcher would have been very valuable in order to increase validity.

CHAPTER FOUR

Results

Joe and the reform

Joe considered himself "lost between the old curriculum and the new reform". Since he started teaching only last year, the reform was already supposed to start being implemented in his school but no rigorous measures were taken. He said he honestly never saw the new curriculum but he was applying some parts of it. He picked up information about the reform by bits and pieces. When I asked him what he thought the difference is between the old and the new curriculum, he said it was the approach. The new curriculum focuses more on "themes and projects...and on the interest of the child instead of the subject" (interview, Jan. 28).

Joe said that the reform affected his work mainly in the way he evaluates his students. Last year it was easier for him to identify who passes a subject and who does not: grades on exams mainly defined that. "This year it is an objective of the reform that no student fails..." (interview, Jan. 28th) and it is quite difficult according to Joe to evaluate a student according to his own achievement and not in comparison with the group. He said he uses codes when he grades the exam: "a" means that the student needed assistance on this question. There is no way a

student does not answer. He always does, with or without help is the issue and Joe aims at having all students achieve without help. Where teaching material and curriculum is the issue, Joe did not know if there is any difference between the old curriculum and the new one. He still used the same books and did not have any training in the new curriculum. Aside from evaluation procedures, nothing changed in his classroom since last year.

Teaching strategies

During the whole period I was conducting my research in Joe's classroom, over a period of two months, the big picture was "the project". Actually, all science lessons revolved around the projects. There were two of them: electricity and acid rain.

Electricity was a major section of the science textbook. Joe chose to approach this section through an electricity project. Students were divided into groups. They had a choice of changing groups if they were not comfortable with the teacher's choice. In one case, one boy switched groups. His choice was mainly a result of his project choice was similar to another group than the one he was originally assigned to. They were to choose any electricity project and build it. They were provided with books in the classroom as well as in the schools' library to provide them with ideas. However, they were not limited to these resources. Some of the

basic material came from the school, such as tape, scissors, glue, cardboard boxes... Other material came from the teacher's own pocket, such as batteries. The rest of the material was left to the students' resourcefulness.

Although students had time allotted to them to work in class on their projects, some of them preferred to continue at home, during weekends and holidays. While some students met outside the school to continue their work in groups, others took charge of doing the project for the group by themselves. Joe told me that the students who met outside the school were mainly of the same ethnic background. They were used to getting together after school to study and to use their native language in order to explain to each other what was not understood in class. In one of the groups, the four boys decided collectively to work individually on different projects. However, they chose a common theme. They all built boats that work with batteries generated electric current. It was interesting to observe the delicate balance between encouraging the students to participate and respecting their boundaries. The group work was a very important feature of Joe's teaching strategy. However, one student in particular was reluctant to work in a group. This student, Ali, knew what he wanted to do from the beginning. He stood out in the class. He was always there, talking or moving around the class. If material was needed, Ali was the first one to go get it. Many of Joe's calls for quiet were directed at Ali. When it came to the project, he could not wait for the other assigned members of his group to get ready. He worked on his boat after school and during the weekends. By the time all students decided what to do for

the electricity project, Ali's project was ready to go. Joe dealt with this by keeping Ali in his group to share not his boat but his "boat building expertise" as he called it. After the session where this decision was made, Joe told me the reason for his decision:

> ...If I ask him to do the boat as a group, you know, like it was supposed to be, then Ali will do all the work... he is fast... what will the others do? I know he will pretend it was group work... the work will be done by him...at home, I mean.. maybe over the weekend...he loves building stuff...(Joe, Personal communication, Feb.17, 2002).

Actually you could see Ali's boat influence on the other three boats that were constructed in his group, but you could also see the personal input of each of the boys.

During the whole project, Joe was there to back them up. He provided them with books on how to construct projects to give them ideas. He bought them batteries when the school could not provide any. One of the groups started with building a city. They drew houses and windows inside a cardboard box and attached tiny bulbs to the windows. All of the bulbs were connected to a battery. Joe accepted the idea and told them he could not wait to see what it would look like once they do all the things that can be done to this city. After that session, Joe expressed to me his disappointment: "They just don't seem excited... It's not like they didn't have resources.. but this is what they want... not even a light switch.. none of the circuits we talked about before... we discussed this for so long..." (Joe, personal communication, Feb.20, 2002). On the day of the project presentations, the girls'

project did not work, but Joe's eyes were filled with pride. Over a few weeks time, the cardboard city had undergone metamorphosis. Complex circuits were installed for the streetlights and houses. The girl's embarrassed look soon disappeared when Joe said: "you know you still have time to check your connections before the big day.. It will work.. it looks great. It must be something loose. Keep working on it" (Joe, Mar.12). He told me after the presentation: "It was working very well yesterday.. You didn't see it... I guess it was a loose connection or something...it was really nice" (Joe, Mar.12). Why the metamorphosis? Weeks of hints, tips and encouragement from Joe...

As the project of electricity was going forward, simultaneously with the other sixth grade class in the school, Joe was preparing with the teacher of the other class for a common presentation of the projects once everyone was ready. The presentation in the classroom was only a preview. He repeatedly insisted that all students have something to say in oral presentation. He followed up closely every one of the eight projects and most of all he told every group he believed in their project while giving them tips to improve it. Along with teamwork within each group, Joe encouraged interaction between different groups. He asked group members to get assistance from other groups that succeeded in some parts of the project (building a home-made fan or switch etc.).

Around the time that the electricity project was beginning, a researcher from a university in Montreal doing a project on acid rain approached Joe and the other

class teacher (See Appendix B). The project was going on concurrently with several schools in Europe and North America. The other teacher refused to participate in the project for lack of time. Joe agreed to participate. He thought the topic an important learning experience for his students. So, alongside the electricity project, the acid rain project was taking place. The first part consisted of collecting information on acid rain. The students did collect information. They looked interested in the topic.

This project was also carried out in groups. Students had a say in the group they belonged to. Roles were distributed among group members. The first assignment for the groups was to find out information on acid rain. This part of the project stretched for a few weeks. When it was time to share the findings, the secretary in each group wrote down the ideas of the other group during a brainstorming session. Information was then written on the board as each group presented it. The classroom did not look to me as a one-man-show, it was a twenty-four-members' band. At this point, Joe showed interest in all ideas and did not criticize any information even if it was incorrect. When students seemed to have difficulties remembering what they had looked up, he helped by asking probing questions. He encouraged them by offering "points" to the group that produced the most ideas. Discussion, which was the most common aspect of Joe's lessons, centered on the students not the teacher. As Joe wrote down their ideas on the board, he asked for their help to organize them in meaningful patterns and ended up forming small concept maps. He also encouraged students to link his writing to their language

lessons (correcting grammar and spelling mistakes). Joe tried in several of his lessons to help students acquire the right terminology in French. If they used a word in English instead of French he would give them the right term and repeat it in French (e.g. "ampoules" instead of "batteries") He always insisted on the correct terminology.

The project looked like it had promising potential. Nevertheless, despite Joe's effort to keep going, the project was put on hold- at least while I was there. It was not realistic, time wise, to expect students to work on both projects. The time allotted for science in their schedule was simply not enough to realize all what they were planning to do. There were exams and evaluations to be done, homework to be corrected and many extracurricular activities to interrupt the plans. Joe was disappointed. He had hopes for the project and his class worked hard on it. They worked on it one to two sessions a week (See Appendix C)

Cultures in the classroom

No classroom could have been more diversified than Joe's. Most of the ethnic groups that exist in Montreal had a representative in this classroom. You could see the diversity in the faces as well as in the behavior. A myriad of communication styles and attitudes existed in he classroom. You see the shy and the extrovert, the student who looked you straight in the eye and the one that

diverted his gaze when speaking to the teacher, the student who avoids public speaking and his friend who wants to be the center of attention. In rare instances, remarks of a cultural nature where said. For example, a joke on a name that sounded Chinese for some students or a "he doesn't understand French!". Aside from that, the only reminder of the ethnic structure of the classroom was the recurrent difficulty student faced finding the right word in French. Every time, Joe would step in to give the missing word or to translate an English word. During the oral presentation of the electricity project, one student had trouble finding his words in French, students laughed at him but he did not seem as bothered by their laughter as by the difficulty he was facing in trying to express himself. The teacher tried to encourage the student to find his words and ignored the reaction of the other students. Throughout my observations, I did not see any proof that students from different ethnic backgrounds did not interact. When I discussed this point with Joe, he told that this is the case in the classroom only. However, once they are in the playground, they immediately form ethnically homogenous groups and use their native tongue. After school, the situation continues, especially because they study together at home. One of the reasons this was taking place could be attributed to the fact that all students did not fluently speak a common language. They already had great difficulty speaking French in class where they had no other choice. Once they had a choice, they preferred speaking their own language.

ISAHUMAKI was the name of one of the groups in the electricity project. Joe later explained to me that the students enjoyed making up names by putting together parts of their names. The results were as unique as the composition of that classroom. Joe seemed to consider the name that he was having a hard time pronouncing as common as it could be. When one of the groups decided on their new group's name, one of the students shouted: "it's a Chinese name!" The students thought it was funny, but the teacher asked them very seriously to be calm and totally ignored the remark.

CHAPTER FIVE

Discussion and implications

After years of debate on multicultural science education, few approaches seem to make it to the headlines. Through my observations in the classroom, my discussions with the teacher, and my close inspection of the new reform curriculum, I was able to cross-examine the reality of this particular classroom with the curriculum expectations in the light of approaches suggested by literature in the field of multicultural science education. The former Minister of Education, Francois Legault, outlines the intentions underlying the New Education Program in the Preface of "Quebec's Education Program" as follows:

> This rich, diversified program focuses on learning adapted to young people's reality, ensuring the development of general competencies that are essential both in their academic careers and in their lives in society... It…[encourages] students to make connections between their learning and real life…

In a multicultural society as is the case in Montreal, for example, the real life for students has at least two facets: home and school. Making a connection between learning and real life starts by making a connection between learning and home.

An important link to be explored is the link between science and technology and real life. In the curriculum, the logic of the market place is expressed through encouraging students to "take an interest in the design, production and marketing

processes " (p.168). So let us have a look at how the new curriculum defines the relationship of S/T to society. The program acknowledges the impact of science and technology on society and encourages students to exercise "critical judgment in assessing the impact of mathematics, science and technology on individuals, society and the environment" (p.138). It also encourages them to critically explore the ethical issues that S/T raise. In chapter 6.2 of the program, it is explained that science and technology are "developed in relation to certain cultural references" (p.161). There is also recurrent emphasis on the relation between cultural awareness on the one hand and historical, social and ethical issues on the other hand.

Joe's classroom contradicted a lot of what researchers point out as problem areas in education today. According to Barba (1998), the current American classroom is driven by teacher-talk and depends heavily on textbooks. Joe's classroom did not show this kind of problem. The textbook in Joe's class was "Memomag". However, aside from a couple of exercises on electricity, Joe never used the book in class. He relied, in part, on worksheets he prepared for his class. The projects, discussions and activities were mostly student-centered. There was always room for student-initiated questions, independent thought and interaction between students. They were encouraged to carry out their own experiments, make their own analogies and come to their own conclusions. On the other hand, in no single instance did Joe attend during my presence in his classroom to the multicultural aspect of science education, neither explicitly nor implicitly. Culture was never a

science issue in class. If Joe believed in the existence of a multicultural dimension to science education, it did not show. There was no sign of encouraging students to make a connection between home, cultural background and school. Aikenhead (1994) emphasizes the importance of this connection. "Interactivity among pupils and content relevancy for pupils' lives are two criteria that seem to make the biggest difference to pupils' meaningful achievement in science" (p.19).

The acid rain project was a great opportunity to draw this connection. There was room for comparison of pollution in different countries. This could have enriched the discussion and allowed student to seek an additional source of information that is not alien to them: their parents. During the discussions on electricity, not once was a science figure from "another culture" mentioned. I was not able to identify any attempt to connect home and school. The acknowledgement of the cultural dimension to education in general and to science education in particular is not only absent from the classroom, but from the curriculum itself too. The program discusses science education as culture-independent. It explains that one of the goals of science education is to help students to "become familiar with specific ways of observing the phenomena around us [...][and] with the types of reasoning that make it possible to deal with scientific and technological problems" (Québec, p.161). These goals do not attend to the fact that the ways of observing and the types of reasoning are culture-laden. Barba (1998) discusses the effect of this attitude:

> Historically, many culturally diverse children have encountered school science taught in a culturally unfamiliar manner as well as in an unfamiliar language. As a result these students never acquire the desired level of language proficiency, nor do they "understand" the science and mathematics concepts taught in the classroom (p.14).

One important feature of the way Joe dealt with his students is that he did not treat them all alike. He understood that they were diverse in every way and accepted them the way they were without forcing them to adapt new ways of behaving. This was very clear in the way he allowed his students to work individually if they were not comfortable working in groups, although he encouraged them to interact. He often asked them to speak up but did not seem to mind at all the absence of eye contact. He did not give any remark to any of the students on their communication style. He also had a very clear idea about each student's background. He told me that Ahmed, for example, would not accept any request that can sound like an order because he was treated like a king at home.

A classroom like Joe's, in general, can be a perfect ground to nurture a multicultural education and to provide a place for students from different ethnic backgrounds to develop in a positive atmosphere. However, in the case of Joe, the positive attitude was not structured or intended to nurture multiculturalism. Joe admitted behaving the way he did imply because he saw it as the best way to teach his students. For him, it was only natural to accept differences and to respect individual traits while encouraging interactions and exchange.

Without any particular effort on the part of Joe to implement the use of teaching strategies that are appropriate for multicultural education, several of these strategies were present in his classroom. For example, Joe encouraged student's interactions and positive experiences of ethnicity. He relied on cooperative learning and peer tutoring that are considered highly effective in meeting the needs of culturally diverse students. In accordance with culturally sensitive instruction strategies, Joe accepted discrepancies between pupils and their science classes in terms of interpersonal mores and conventions such as eye contact, questioning and authoritarianism. Joe also gave attention to students with language difficulties as well as to the language of science through the continuous effort to teach his students the proper terminology and a correct vocabulary. Multicultural science education calls for teaching strategies that emphasize solving science, technology problems, environmental problems, resource management, and sustainable societies' problems. The activities that Joe chose in his classroom fall into this category.

Although Joe's classroom had many positive aspects, many of the strategies identified by literature as important were not observed. For example, Joe did not encourage collateral learning or assist students in developing new insights and connecting them with their previous learning. He did not relate science education to the history and culture of the students nor did he include examples of scientific contributions made historically by non-western scholars. Although allowing students to use their home language in small group settings for the purpose of

cued recall proved to be an effective learning strategy in multicultural classrooms, Joe did not believe it was a good strategy. For him, the use of French language was almost the only common ground between his students. He thought that if he started allowing students to use their home language, interaction between different ethnic groups would be much less. Moreover, students had the chance to interact enough in their home language outside the classroom. I believe Joe was right on this particular point. Finally, Joe did not put any special effort on using multiple means of data representation. He relied heavily on oral communication instead.

If we were to evaluate Joe's teaching in terms of curriculum application, we would find that it is by chance that some components of the curriculum were actually applied. Joe himself was not aware of it. The reason is that our teacher was not offered any training in the new curriculum or even enough information, besides evaluation techniques, to be able to function in his classroom accordingly. On the other hand, the curriculum itself does not give any practical suggestions for the teachers. It draws the big picture and leaves the rest to each individual teacher. For instance, some of the major goals of pluralistic education are to protect students from the violation of their ethnic cultures and to defend them against self-alienation. Although the Quebec curriculum encourages such positive attitudes as "to respect others and accept their differences, to be receptive to pluralism, to maintain egalitarian relationships with others and to reject all forms

of exclusion" (p.50), no practical dimension to such statements is found in the actual curriculum.

If our teachers are to fully fulfill the expectations of the curriculum, they need practical support. There is also a shortage of suitable resources to assist teachers in approaching elementary science from a pluralistic perspective. The best example is the project on acid rain. This project fits perfectly within all of what Quebec's reform preaches and is an interesting representation of widening the horizons of students and thinking globally. Unfortunately, it was not achieved because Joe had specific subjects he had to teach during the course of the year. He was evaluated by the school, partially, on whether he taught all the specific subjects he was supposed to teach or not. For example, although it could have been a good decision, Joe could not decide to skip electricity in order to focus more on the Acid rain project. He had also time limitations. There was only so much time he was able to spend on science without other subjects to suffer. Another problem Joe faced with the new curriculum is that it depends to a certain extent on the help of the parents. This is not realistic because many parents cannot provide everything that their children need to succeed- nor does the school for that matter.

I cannot say with any confidence that other classes in Quebec, not even the one next door, has a more or less positive atmosphere for students in general and for students from a diverse cultural background in particular. However, Joe's class is

a perfect starting point towards developing a multicultural background. What he needs is the training on the objectives of the new curriculum as well as the multicultural aspect of science education and resources to help his students achieve their potential. It will be very interesting to continue research in Joe's classroom after Joe is given some training in multicultural education and some practical support in applying it. He will be able to identify the positive teaching strategies that he already has and to implement new strategies. The performance and interest of his students in science can be evaluated subsequently in the light of these changes. For now, this research confirms that there are classrooms were culturally diverse students can develop their abilities and potential and it also indicates that some teachers are very open to cultural diversity but lack the formal training in this field. Future research is much needed in schools in Quebec in order to explore how Quebec science program is applied and to observe what aspects of multicultural science education are present in schools where cultural diversity is high and in schools where students are mostly monocultural.

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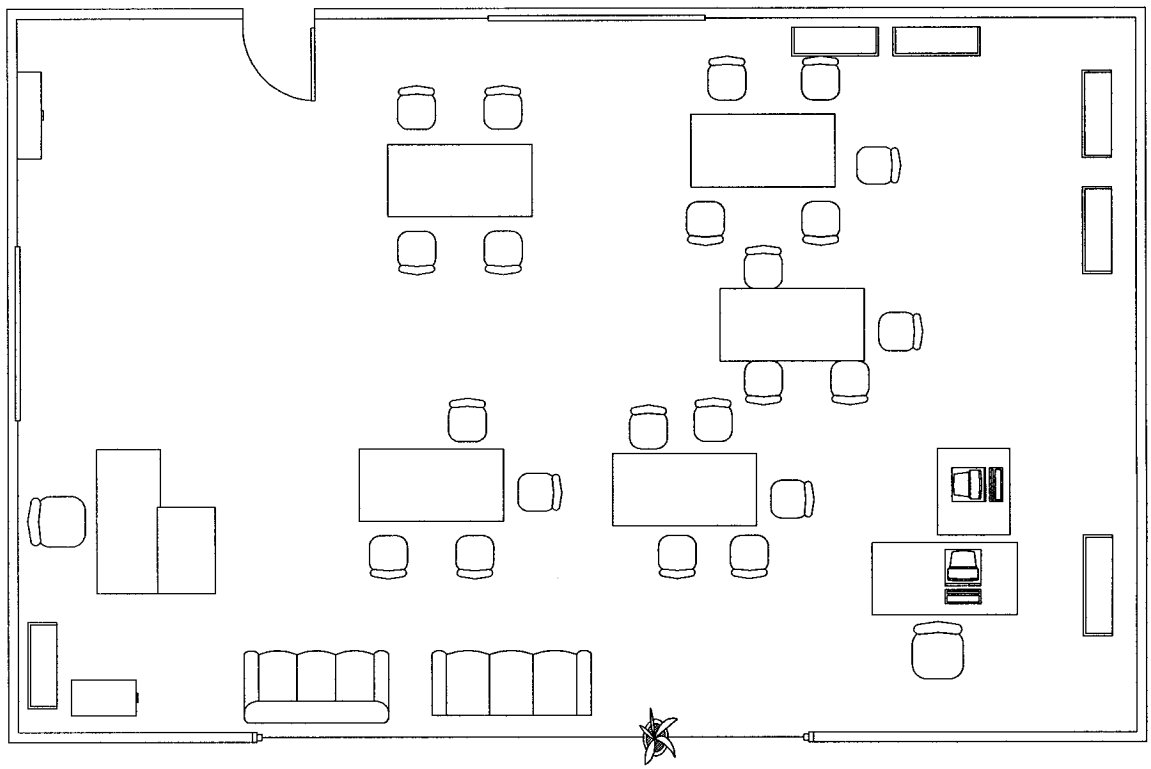
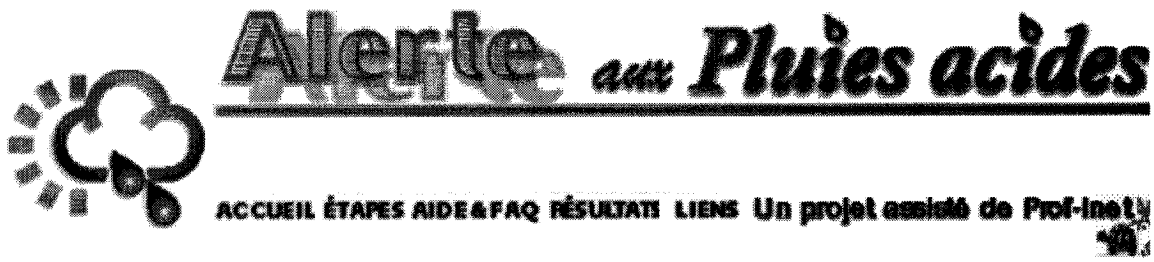
Appendix A **Classroom Layout**



Appendix B Acid Rain Project

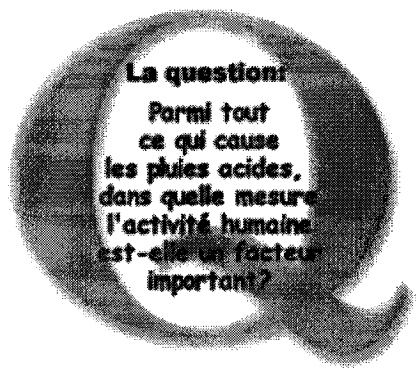
The following is a part of the web-page about the project on acid rain that Joe's class was involved in.
Web-page address:
http://www.cslaval.qc.ca/prof_inet/anim/ac/pluies/projet.htm



- La projet
- En bref
- Curriculum
- Échéancier
- Inscrivez-vous
- Participants
- Évaluation
- Élèves
- Plan du site

Le projet

Lacs limpides mais sans vie. Érables à l'agonie. Grenouilles en voie de disparition. Menace pour la santé humaine... Le coupable? Les pluies acides.



D'où proviennent-elles? Comment sont-elles formées? Les humains sont-

ils responsables de ce
problème?

Joignez-vous à ce projet
dans lequel des classes du
Québec, du Canada ou
d'ailleurs dans le monde
étudieront cette question-
problème, effectueront des
tests pour détecter la
présence de pluies acides et
partageront leurs résultats
pour analyse.

C'est en formulant une hypothèse que les élèves apporteront une *réponse expliquée* à la question-problème (pluies acides et activités humaines). Cette hypothèse permettra aussi de formuler une prédiction quant aux résultats attendus dans l'étude du phénomène dans sa propre région.

Chacune des classes utilisera l'ensemble des données recueillies, analysera ces données en relation avec son hypothèse et communiquera ses résultats à toutes les

classes participantes, constituées en équipe internationale de chercheurs.

Le projet vous fera cheminer à travers toutes les étapes de la démarche scientifique. Les élèves de votre classe devront:

- Circonscrire ce qu'ils savent déjà du phénomène;
- Formuler d'autres questions à partir de ces connaissances;
- Poursuivre de nouvelles recherches et compléter leurs connaissances;
- Formuler une hypothèse de réponse à la question-problème et la justifier;
- Faire des prédictions sur les résultats qu'ils s'attendent à obtenir dans leur région;
- Mettre l'hypothèse à l'épreuve en rassemblant des données empiriques sur des échantillons de précipitations;
- Partager leurs informations avec l'ensemble de leur communauté scientifique (les autres classes qui participent à la recherche).
- Analyser les données à la lumière de leur

hypothèse.

Comme il s'agit de l'étude d'un phénomène réel, les élèves seront invités, à la fin du projet, à passer à l'action en posant des gestes concrets en faveur de l'environnement.

Animateur du projet: André Côté

Courriel: andre.cote@ens.csaffluents.qc.ca

Niveau de difficulté du projet:

Caractéristiques pédagogiques: projet qui demande préparation; implique un apprentissage par projet; permet l'intégration de disciplines; met en application la démarche scientifique.

Au plan technique (TIC): projet facile à réaliser techniquement (utilisation du courriel et communication via un babillard).

Clintèle visée:

Nous souhaitons réunir des classes du Québec, d'ailleurs au Canada et aussi d'autres pays, travaillant en français.

- Un premier groupe sera formé pour les classes du 3e cycle du primaire (10-12 ans)

- Un second groupe sera formé pour les classes du secondaire (4e cycle),

  Ire et IIe secondaire (12-14 ans)

Disciplines visées:

Au primaire (10-12 ans): Ce projet offre principalement un contexte favorisant l'intégration d'activités en **Science et technologie** et en **français**. Il trouve également des applications en **mathématique**, en **géographie** et en **Science physique de l'environnement**.

Au secondaire (12-14 ans): Ce projet offre principalement un contexte favorisant l'intégration d'activités en **Science et technologie** (écologie) et en **français**. Il trouve également des applications en **mathématique**, en **géographie** et en **Science physique de l'environnement**.

Échéancier:

- Période d'inscription: 1 novembre 2001-14 janvier 2002
- Période de réalisation du projet: du 21 janvier 2002 au 30 avril 2002

Les activités d'apprentissage et d'exploration du phénomène des pluies acides commencent dès le 21 janvier dans votre classe

Fréquence des communications

Chaque étape du projet (sauf l'étape 3) nécéssite le partage d'informations et de résultats. Un babillard virtuel est à la disposition de toutes les classes pour ces échanges ou pour toute autre communication relative au projet. Les enseignants des classes participantes pourront également communiquer entre eux à l'aide d'une liste de distribution.

Logiciels et périphériques susceptibles d'être utilisés dans le cadre de ce projet:

- Courrier électronique
- Traitement de texte
- Babillard virtuel sur page Web (fourni)
- Fureteur (Netscape, M.S. Internet Explorer,...)
- Imprimante

Autre matériel requis (veuillez prévoir dès maintenant):

- Rouleau de papier indicateur pour mesurer le pH (échelle comprise entre 4,5 et 7,5/ graduation de 0,5... **ou préférablement,**
- un pH-mètre électronique (l'école secondaire de votre région pourrait peut-être vous en fournir un; sinon, essayer d'en prévoir l'achat)
- de l'eau distillée
- Un cylindre gradué ou un «pluviomètre» pour mesurer les précipitations en millilitres (ml).

Où acheter un **pH mètre** ou du **papier pH** ?

Liens avec le curriculum

Compétences transversales:

- Compétences d'ordre intellectuel
- Compétences d'ordre méthodologique
- Compétences de l'ordre de la communication

Domaines généraux de formation:

- Environnement et consommation
- Médias

Domaines d'apprentissages

- Langues
- Mathématique, science et technologie

Appendix C **Examples of the class schedule**

Schedule Feb.3rd to Feb.6th

PLANIFICATION SEMAINE DU 3 FÉVRIER AU 6 FÉVRIER

	LUNDI	MARDI	MERCREDI	JEUDI	PÉDAGOGIQUE
8 :30 À 9 :30	ARTS	SC. HUMAINES HISTOIRE DE L'IMMIGRATION	MATH OPÉRATION SUR FRACTIONS	MATH : RÉSOLUTION DE PROBLÈMES OPÉRATIONS SUR FRACTION	
9 :30 À 10 :11	math : ÉMIR	GRAM. PHRASES COMPLEXES	MATH OPÉRATION SUR FRACTIONS	DICTÉE ÉMIR	
10 :11 À 10 :30			RÉCRÉATION		
10 :30 À 11 :30	math : ÉMIR	MATH DÉCIMALES	BIBLIOTHÈQUE INFORMATIQUE	CORRECTION DEVOIRS	
11 :30 À 12 :43			DÎNER		
12 :46 À 13 :46	CORRECTION ÉVALUTIONS DE LECTURE	SC. NATURE EXPÉRIMENTATION ÉLECTRICITÉ	GYM (RENCONTRE AVEC PSYCHO-ÉDU POUR ____-)	ANGLAIS	
13 :46 À 14 :05			RÉCRÉATION		
14 :05 À 15 :06	DEVOIR ET LEÇONS	TUTORAT	AUTO-ÉVALUATIONS FRANÇAIS : GRAMMAIRE	PÉRIODE LIBRE, PROJET OU BALLON-BALAI	

Schedule Feb.10th to Feb.15th

PLANIFICATION SEMAINE DU 10 FÉV AU 15 FÉV

	LUNDI	MARDI	MERCREDI	JEUDI	VENDREDI
8 :30 À 9 :30	ARTS	ÉCRITURE THÉÀTRE	SKI DE FOND?	sortie Mt-Royal???	CORRECTIONS DES DEVOIRS
9 :30 À 10 :11	SC. DE LA NATURE TEMPÊTE D'IDÉE PLUIES ACIDES	ÉCRITURE		ACTIVITÉ DE LECTURE JOURNAL MÉTRO	SORTIE THÉÀTRE
10 :11 À 10 :30			RÉCRÉATION		
10 :30 À 11 :30	MATH : RÉSOLUTION DE PROBLÈME	MATH : ENTIERS RELATIFS			SORTIE THÉÀTRE
11 :30 À 12 :43					
12 :46 À 13 :46	PRÉPARATION SORTIE THÉÀTRE VOLET LECTURE	EXPÉRIMENTATION SC. NATURE ÉLECTRICITÉ			ANGLAIS
13 :46 À 14 :05					
14 :05 À 15 :06	MATH : GÉOMÉTRIE MESURE D'ANGLES	PRÉPARATION SORTIE THÉÀTRE VOLET LECTURE			PROJET ÉLECTRICITÉ

Schedule Feb.17th to Feb.21st

PLANIFICATION SEMAINE DU 17fév AU 21fév

	LUNDI	MARDI	MERCREDI	JEUDI	VENDREDI
8 :30 À 9 :30	ARTS	MATH : NOMBRES À VIRGULES OPÉRATIONS			VISITE INSECTARIUM
9 :30 À 10 :11	LECTURE				VISITE INSECTARIUM
10 :11 À 10 :30			RÉCRÉATION		
10 :30 À 11 :30	MATH :RÉSOLUTION DE PROBLÈMES	GRAMMAIRE	BIBLIOTHÈQUE INFORMATIQUE		VISITE INSECTARIUM
11 :30 À 12 :43			DÎNER		
12 :46 À 13 :46	GRAMMAIRE	SC. HUMAINES	GYM		ANGLAIS
13 :46 À 14 :05			RÉCRÉATION		
14 :05 À 15 :06	recherche d'info sur pluies acides	PROJET ÉLECTRICITÉ	GÉOMÉTRIE : DÉPLACEMENTS TRANSLATIONS	GÉOMÉTRIE : DÉPLACEMENTS TRANSLATIONS	projet électricité
devoirs	recherche d'info sur pluies acides	recherche d'info sur pluies acides			