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Rural Roots, Urban Harvest, and Giving Back to the Land

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ACCLAIM's mission is the cultivation of *indigenous leadership capacity* for the improvement of school mathematics in rural places.

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By Martina Schmidt

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Abstract

This paper is the personal journey of one teacher from a rural childhood, through a small university, to a rural school, and eventually to the city. It contrasts the intense challenges that rural teachers and students face with the unique opportunities afforded them by virtue of being rural. It includes an attempt to piece together the factors that influence high teacher transience rates in rural areas, a discussion of the pedagogical restrictions and freedoms offered by rural areas, and an exploration of possible ways that rural areas could reach out to their urban counterparts to help city kids understand their own inescapable connection to the land.

Factors affecting transience rates include: (a) social isolation, long commutes, or both, (b) professional isolation, (c) demanding workloads as small staffs struggle to cover school responsibilities, (d) limited employment opportunities for life partners to find work in the same community, and (e) lack of long-term connection to the land.

Pedagogical restrictions include (a) multi-graded classrooms, (b) demanding workloads, (c) limited budgets, (d) lack of professional support, and (e) the adverse impact of teacher transience on program continuity.

Conversely, country schools offer many benefits: (a) small class sizes, which provide a unique opportunity to better understand children and how they think, (b) the potential for real-life contexts in which to embed many classroom experiences, (c) a less-restricted environment in which to explore innovative ways of teaching, and (d) a potential source of rich outreach to urban children regarding the world's food supply and our own connection to and dependence upon the land.

Rural Roots, Urban Harvest, and Giving Back to the Land

By Martina Schmidt

The quality of rural mathematics education is inextricably linked to the difficulty in keeping teachers in rural areas for extended periods of time, to the nature of rural life, and to broader pedagogical issues that can manifest themselves uniquely in rural settings. Rural life can be very lonely, both personally and professionally, for those whose roots are not deep within the community and the land that sustains it. Teaching loads can be overwhelming, as small classes are combined to reach acceptable pupil-teacher ratios and as small staffs are thinly spread to fill the many extra roles that are necessary to school life. This often prompts people to stay only as long as they absolutely have to before they move on to other jobs in larger centers. As much as rural schools have unique challenges, though, they also provide unique opportunities. The practicality of rural life and its connection to the land that sustains us all provide a rich context for teaching children everywhere about the math and science of ecology. Furthermore, the structure of small rural schools is often ideally suited for implementation of inquiry-based teaching models that are less enslaved by curricula and by what has "always worked." To borrow a phrase from the Dixie Chicks, rural schools are embedded in "wide open spaces" with "room to make [some] big mistakes." What we need are ways to keep people in the country so that they don't make their biggest mistakes there and then move on. Challenge and opportunity abound in rural education, and I have tried to weave my perceptions of these into a narrative that encompasses my own experience. I begin with a commentary on my own rural roots, continue with the seven years I spent in a rural

school, and then discuss the reasons why I ultimately left. Throughout this discussion, I have included a broader reflection of the role that my years in the country played in shaping my understanding of teaching and learning, and I culminate with a discussion of the unique role that rural areas could play in helping all students rediscover their connection to the land.

Teacher Transience

Why is it so hard to keep teachers in the country? There are some wonderful advantages to rural life. Unless you grow up there, though, the beauty of country life is not always evident. I did grow up there, taking lunches to the fields where my dad and brother worked long hours through the summer, helping my mom grow a huge a vegetable garden and preserve copious amounts of food for the winter, raising my own beef steer through my involvement in 4-H, and seldom traveling further than the nearest town, which then had less than 10,000 people. These experiences fundamentally shaped the way I look at the world. However, I had already left home by the time I reached my seventeenth birthday. I loved school, and it seemed to be assumed that my brother would be the farmer. He worked with my dad and the hired hands in the fields and with the cattle, while my sister and I tended the house, yard, and garden with my mom. I don't even remember a time when I didn't know that I would go to university after completing high school. I think even then I knew that, as much as I loved the farm where I grew up, it wasn't really safe to put down deep roots. I knew that the only realistic way that I would ever live on a farm was if I married a farmer, and I had enough mathematical savvy to realize that if I limited my choice that severely, the probability of finding a good

soul-connection while I was still in my child-bearing years could be slim. At the tender age when those thoughts were already taking root in my mind, I was still pretty unconvinced that I would ever get a boy to even look at me, which further fueled my belief that it may not be a good idea to narrow my options too much! Besides, I was fiercely independent from an early age, and I wanted a career that would allow me to stand alone if I wanted or needed to. I didn't want what I then perceived to be my mother's subservient role.

I eagerly moved to Medicine Hat (population 55,000) for my first year of college the summer after I finished high school. I was yearning for independence and loved being on my own. I completed my degree in the small city of Lethbridge (population 80,000) and landed a temporary contract within the city. Budget cuts at the end of the school year eliminated all new staff, so I accepted my first full-time job in the tiny farming community of Hays, Alberta (population <100). I was back in the country, only forty minutes away from the farm where I grew up and where my parents and brother still live today. Unlike many colleagues who had found themselves in similar "predicaments," I wasn't worried about working in the country. I found a tiny house in the nearby hamlet of Vauxhall (population 1,000) and drove about twenty minutes a day to work. Some of my colleagues preferred to commute from Taber (forty-five minutes away, population 3,000) or even Lethbridge (an hour and a half away) and kept their eyes open for positions closer to their homes. The exceptions were those who had formed deeper connections with the community by marrying farmers and who were therefore tied to the land itself.

The community, well aware of this binding factor, was eager to help me find similar roots of my own. I was quickly invited to join the local Mennonite church and often made aware of any single young men in the community. Unfortunately, "young" was taken to extremes! The first boy my students thought to be a good match was in Grade Eleven. They had to drag him off the high school bus at the end of the day to introduce him to me. Their next choice was the seventeen-year old hired hand at one of their farms. When I didn't follow up with the phone number they handed me one morning, they waited for the Christmas concert, always well attended by the entire community, to introduce us. Sensing my reluctance, some of my Junior High students somehow lured me into the staff room (only one exit, not counting windows) then brought Fred to the door. Although I questioned their perceptions of good matches for me, I certainly felt cared for by this well-meaning bunch of kids.

Living in the country was not difficult, but my job description was daunting. My neglected social life was a minor concern at this point, because I ate, slept, and breathed teaching. By Christmas I was emotionally and physically worn out and moved home. I needed to be around people who loved me regardless of how my lessons went and around activity that wasn't centered on the school. My hometown was just far enough away that I could escape to the identity of "Marg and Chris' oldest daughter," rather than "the new teacher," whom even the locals in the coffee shop with no children in school somehow recognized. At that point, the fact that I wasn't quite "Martina" was not in the forefront of my mind. It also helped that my dad could explain electricity in practical terms, that my mom would sometimes stay up until 1:00 in the morning to help me keep up with my marking, and that I had the luxury of excellent meals without the expectation of

household responsibilities. This in itself is clear testament to the crazy hours the job required; as children, we always had plenty of responsibilities!

First-year teaching is difficult at the best of times, but I was sorely unprepared for the challenge that awaited me in Hays. I was responsible for twenty-three multi-graded seventh, eighth, and ninth-graders. To this group, I taught Science 7 and 9, Social Studies 8 and 9, Math 7, 8, and 9, as well as Drama, Health and Outdoor Education. The principal had to teach almost full time, so while she picked up the Junior High Language Arts program, I had to take Social Studies and Science 5/6, Drama 4/5/6, and Computer Studies 4/5/6. I had two thirty-minute prep periods per week. As a new teacher with many high ideals, I was firmly against note-taking and lecturing as primary modes of instruction, yet I was very much a rookie with regards to how to organize a classroom for successful inquiry and sadly lacking in content knowledge that went much beyond the textbooks I was so reluctant to use. All of this was complicated by the fact that there were almost always two and sometimes three completely different activities going on to accommodate the different grade levels of the students. With the equivalent of approximately four full-time teachers in the entire K-9 school, other responsibilities were equally difficult to spread out; I became the school's union representative, PD representative, technology coordinator, science fair organizer, and students' union advisor. Thankfully, the Grade 3/4 gym teacher was very athletic and handled most of the coaching. The staff, students, and parents in Hays were wonderful. For the most part, they recognized the magnitude of the load that had been placed on my shoulders and were generally forgiving, encouraging, and happy to help out. I'm sure that being hardly more than a kid myself (I was twenty-one at the time) and the fact that I was practically

homegrown both acted in my favor. To a certain degree, I think I was accepted because I was one of them. When I was asked to speak at their annual 4-H awards banquet, I chose as my topic, "The Privilege of Growing Up Rural."

Although the workload was overwhelming, there were some wonderful advantages to teaching in Hays, especially when it came to teaching science. Aside from a small bit of cultivated grass and a tire playground, the surrounding school ground was all native prairie grassland, and an irrigation ditch and accompanying marshland bordered the east side of the school's property. Farms are filled with science, so every time we started exploring a new topic, the kids had many personal experiences to bring to bear upon it. I'll never forget the time that one of their fathers phoned in with the news that he had a stillborn, disease-free calf: Would we like it for science? Dissecting it was going to be extremely messy, so we plopped it on the sidewalk outside the classroom window, and I let three eager Junior High boys go to work on it. I stayed inside with the others, but I'll never forget the image of Jared banging on the classroom window, bloody to his elbows, holding a large mass of calf guts, and shouting excitedly, "LOOK! I got the intestines!!" By the end of the operation, they had collected some of the internal organs, laid them out neatly, and brought them in to share with the class. Despite living in a familiar world rich with scientific and mathematical context, I struggled with the detailed complexity of the Junior High Program of Studies. I had so much to learn and didn't always appreciate the significance of those endless bulleted expectations. I wanted the kids to learn through experience and inquiry, but I didn't always see ways to contextualize everything. With two or three classes happening simultaneously, I also needed (or thought I needed) a way

for one class to work independently while I worked with the other. At times I gave them structured tasks with clear expectations. At other times, we just dealt with the chaos.

Math was most difficult in terms of trying to structure meaningful programs for three different classes, and it consumed the vast majority of my time. The method I chose to deliver the program was highly inefficient but, I hoped, comprehensive. I had few ideas about how to create contexts for math objectives, so the majority of the time we followed the textbooks. Rich contexts were all around me, but I had not yet learned to see the world through mathematical eyes. Each of the three classes worked on a separate program. Although I had achieved near-perfect scores on both my math and physics diploma exams at the end of Grade 12, I did not feel at all smart in math. I set out to understand why all the rules work, and I tried to teach from this perspective. I was also very concerned that the kids knew the procedures that would allow them to complete their work, and this led to many difficult contradictions. If the students spent all their time trying to figure out why, there was little time left for practice (unless they did nothing but math!). Also, they needed guidance in the process of thinking their ideas through, and by the time I rushed from the Grade 7s to the 8s to the 9s, I couldn't seem to find the extended time needed for these conversations. I tried to teach them the reasons behind the procedures I expected them to use, but, due to time constraints, found that I wasn't always able to provide the guidance they needed to help them think through their ideas on their own and to develop confidence in their ability to determine rational procedures. I didn't have time to mark with each grade individually, either, so I ended up making detailed keys with marks for each step of the work I expected them to show. I wanted them to know the reasons behind what they were doing, but the system offered

very little freedom and in actuality provided little more than longer lists of things to memorize. Capable students could use the keys to help build their own understandings, but capable students tend to do that anyway. Treagust et al. (1996) emphasize the idea that "students actively construct their own knowledge whenever they learn something" (p. 5). Millar (1989) echoes this point: "Most of us who think we 'understand' some science concepts did not arrive at this understanding by experiencing teaching programmes structured on constructivist lines" (p. 589). What about the kids who don't do this naturally? What about those who *could* do it naturally but almost always wait for permission to do so and then require some sort of guideline just to ensure that they're living up to expectations?

On the other hand, I learned most of what I know about teaching from my Grade 5/6 Math and Science classes in Hays. I was less threatened by the younger kids: there were only two grades to manage rather than three, there were only eleven students in the class, the curriculum was easier to understand, and there weren't as many detailed content objectives. It was much easier to hear all of their voices, and it was those voices that eventually inspired my Masters thesis on children's reasoning, expressly in science, but much more broadly applicable. They were like a breath of fresh air in my overwhelming days, and, because I was utterly unable to cope with everything, theirs often was the group that received the least prepared lessons. This taught me to look to them for inspiration more so than I might have otherwise. Hearing their ideas, listening to their questions, and allowing their questions to guide so much of what we did taught me how very important it is to follow *their* lead. It taught me that sometimes it pays to push their discussions past the first signs that the kids are running out of ideas and

arguments. It also taught me that what seems like understanding often is not, especially when I was struggling right along with them to get to the bottom of complex ideas. I realized that I shared many of their misconceptions, and I started to appreciate the importance of using those misconceptions as launching points for moving toward accurate ideas. I braced myself for skeptical questions from parents but found instead that they were surprised and happy that that their kids were coming home talking with interest about science and math. I may not have been able to accurately quantify what their children were learning, but the parents could see how much their kids enjoyed these classes and could see that they were very engaged in deep learning. As a result, they didn't demand pacification with marks. Wide open spaces, indeed. I included the 5/6 class of 1998 in the dedication to my Masters thesis.

Now that I teach in the city, I know that I have much more room than I would likely have dared pushed the boundaries to discover had I not started out in Hays. I *do* have that kind of space here, but my years in Hays taught me to see it. When I first moved to Calgary, I was still very worried that, having emerged from my rural enclave, somebody was finally going to call me on my unorthodox approaches. After all, I teach in a school explicitly dedicated to science and math that draws from a population that values these disciplines very highly. Many of the parents work in science or math-related fields. I was sure that my inadequacies must come to light in such an environment. Again, however, the overwhelming feedback from the first set of parent-teacher interviews was that parents couldn't believe how much their kids now loved school and how much they talked about what they were learning. It took me a long time to get over my fear of being "found out."

At the end of my first year in Hays (and every year thereafter), I took my entire Junior High class on a three-day survival camp for which each group of four or five students had to organize a menu, pack food, build a shelter, and cook over a campfire. While there, we did archery, target-shooting, and signal-fire building. To do this sort of thing, we needed plenty of adult supervision, and dads were particularly willing to help out. One day, one of my eighth-grade girls came to me and asked if it was okay if her dad's friend came along a supervisor. "Sure," I said. "Why not?" Unbeknownst to either her or me (she had her own eye on Dad's friend), it was another setup, although not with the intent of rooting me to Hays. When she said "Dad's friend," I assumed she meant "Dad's friend who is Dad's age," which at that time in my life, I would have considered way too old for me! When handsome, shy, twenty-four year old Dean arrived on the scene, I was a little surprised. When we got back to the school, one of the girls saw us chatting at the window of his pick-up, got a wicked gleam in her eye, and ran into the school to create an advertisement for me (something about seeking a boyfriend). Well, it must have worked, because we went on our first date that weekend. We met in a town not frequented by the Hays people, but sure enough, someone spotted me getting into his truck. By Monday morning, my class was abuzz, and the girl who brought him to camp was most unhappy. Nevertheless, the relationship quickly became serious, and we were married two years later. While we were dating, he continued his work in the oil patch, another key industry in Hays, but he lived forty-five minutes away in Medicine Hat. Soon, I was commuting with him every day. The drive was long, so we rented a trailer nearby, just ten minutes away in the hamlet of Rolling Hills. Soon, however, he switched jobs and ended up spending his weeks in yet another small town, this one

several hours away. This was difficult, but it did drag me away from my job for the occasional weekend! Shortly after we were married, Dean moved to the extreme northern part of Alberta, more than 1,200 km away. I followed reluctantly in November, just a few months into the school year, as soon as a maternity leave position opened in the tiny Zama City School.

I think it is significant to our discussion that when I left Hays after three years of teaching, it wasn't to move to the big city, but to a much more remote community where we had to drive two hours for mail. To have roots in a rural community, you need roots to the land or roots to someone who has roots in the land. Unlike farming, which ties you to the same piece of land often for generations, the oil patch is a volatile place. You never know where the next productive wells will be drilled, you never know when the company you work for will be taken over by competitors, and you don't know whether the new company will keep its old employees or hire new ones. Even more significantly, you don't develop a deep bond to your own piece of land when you drive around checking oil wells for somebody else. It is also significant that during the three years I spent in Hays before going to Zama, I moved from Vauxhall to home to Medicine Hat to Rolling Hills. My roots were to the school, not the community. To a certain extent, I actively avoided living there. It's a great community, but I didn't want to be "the teacher" 24/7.

As the year in Zama drew to a close, the teacher whose maternity leave I was filling was undecided about whether she would return. With only three teachers in the school and no drivable roads to the distant neighboring communities (at least not with my truck!), I didn't have high hopes that a position would become available. I accepted back

my old job in Hays. I had already planned to spend my summer at the University of Lethbridge working on my Masters degree, so I left Zama as soon as school let out at the end of June. I lived in residence at the university for the summer and moved into what had once been my grandmother's house on my parents' farm when school started in the fall. Suddenly, Dean and I were facing an indefinite separation. We were naively confident that we could make our new marriage last, but this decision turned out to be the beginning of the end as one year stretched into three and numerous stresses eroded our relationship. While we were apart, school once again became the center of my world. My commitment to furthering my education and to my job in the tiny school in Hays overpowered my commitment to my marriage. He, too, put his career first.

Throughout this difficult time, I was living at home and was incredibly busy with my work. I did long for social and academic connection, however. I moved to Lethbridge to be closer to the university, where I really felt at home, sacrificing three precious hours each day to the highway. I continued to work long hours at the school, all the while stealing whatever hours I could to write my thesis. Professionally, Hays continued to be rich, fertile ground for this work, and my understanding of children's learning and of the process of inquiry in science now infuses the way I teach all subjects. By this time I had begun to develop a strong network of colleagues throughout the province who shared my passion for teaching, and I was starting to develop a reputation as someone who could contribute to various efforts to improve curriculum and instruction. I traveled regularly to conferences, curriculum development meetings, and university-related activities. I was grateful for these opportunities. Hays, with four teachers who taught different grades and subjects, provided a very limited professional

community. Even though Hays nurtured me well and the school division gave me opportunities that transcended the walls of my tiny school, another opportunity soon presented itself.

During my second year of teaching in Hays, I was contacted by the Science Alberta Foundation in Calgary to help design and implement a program to promote science to gifted, disadvantaged students with the hope that they might pursue science-related careers. For my program, I chose interested students rather than gifted students (although some were undoubtedly both) and generally ignored the part about my kids being disadvantaged by being rural. If anything, I thought they were privileged. In hindsight, I recognize that they, like me, would get little exposure to science-related careers and therefore were less likely to choose them as they moved into post-secondary programs. At that time, what mattered to me most was the opportunity to help develop an enriched science program with the support of other teachers with similar interests. I took the program with me to Zama when I moved, then carried on with it in Hays when I returned. It was through the Science Alberta Foundation that I was invited to apply at a new charter school that would soon be opening in Calgary. The charter was based on an enriched math and science program, and the organizers were looking for someone to lead the math/science team. I was utterly torn. It sounded like everything I had always wanted to do. I would be teaching math and science to elementary kids—the best part of my job in Hays—without having to consider the Junior High responsibilities that dominated my unwieldy schedule. Instead of teaching three different subjects in the same time block, I would be teaching the same subject in two different time blocks. It seemed unimaginable. This was the perfect opportunity to further apply the

understandings I had gleaned from my own research and to possibly start to share some of what I was doing with a larger audience. I would even be close to a university if I decided to pursue my Ph.D. I was terrified by the idea of being curriculum leader, but I refused to bow to fear. I believed I had something to offer, and I finally made the decision to move. By August 1999, I was officially teaching in the city. Even then, I decided to live in the neighboring town of Cochrane (population 8,000), which has a great view of the Rocky Mountains. As in Hays, however, I was extremely busy, and I didn't spend much time enjoying the beautiful little town where I lived. Commuting in city traffic was much more stressful than commuting on the open highways from Lethbridge to Hays, so I rented an apartment a few blocks from the school. Ironically, being able to walk to work brought more escape from the city rush than commuting from outside of the city had done.

I now work with people who share my passions, and, partially as a result, I have made wonderful friends. I have also started to enjoy life a little, largely because of the proximity of friends who I connect so strongly with and partly because my workload and commuting time are so much more manageable. Halfway through my fourth year at the school, I married a local, and this time I'm putting the marriage first. His work is in construction, and, even though he shares my dream of a place in the country, we won't find a lot of new construction in places without a lot of people.

For teachers to stay in the country, they seem to need roots in the land, and not just emotional roots. During my time in Hays, the only teachers who stayed for more than two or three years were women with husbands who farmed. Of course, I was the exception to this rule, but ultimately new opportunities drew me away, too. Relatively

few women take over the family farms, and I've yet to meet a male teacher with a wife who farms. Yet marrying a farmer is what caused my mother to quit teaching; the farm responsibilities were more than enough for two. Lack of connection to the land also helped to explain the transience of the student population in the school. It consisted primarily of children who came from long-time members of the community (usually the farm families), those with a parent (usually a father) in the oil industry, and a Mexican Mennonite population who worked as farm hands during part of the year and lived in Mexico for the other part. The latter groups were much less likely to stay.

Perhaps this was not always the case. While I was working on my undergraduate degree, I decided to try to dig a little deeper into the causes of rural teacher transience by interviewing my own former teachers. I was able to track down five of the nine, four of whom had started teaching in Alcoma School (in Rainier, Alberta, also with less than 100 people) in or before 1975 and who remained at the school for at least ten years. The remaining teacher started in 1982 and stayed for six years. All five of the teachers interviewed claimed that they felt strong ties to the community and to the children in the school, all came from rural backgrounds themselves, all expressed a desire to live in or raise their families in a similar environment, and all were married at the time they came to the school. Being tied to a farm was not always a factor in their decisions. In fact, like my mother, one woman's commitment to her family's feedlot is what led her to *leave* the teaching profession. Three of the five teachers lived on small lots and owned no extra land. Four of the five were women. With such a small sample, the evidence is anecdotal, but it does prompt some deeper questions for investigation. Where today are the teachers who would actively seek out a rural lifestyle for their families? Is their disappearance

due to fewer graduating teachers who come from rural backgrounds? Yet I am one, and I choose to remain in a city. Is it because women are marrying later after they have established roots elsewhere? Is it because the teaching profession, especially at the elementary level, is still dominated by women who are unlikely to live alone in the country alone and equally unlikely to move to a place where their husbands are unlikely to gain profitable employment? What did the husbands of the non-farming teachers in my study do for a living?

Working at the Calgary Science School has provided many new challenges and opportunities in which I have completely immersed myself. Interestingly, one of our board chairwoman's guiding beliefs is that if we're not making mistakes, we're not pushing the boundaries as much as we should be. Here, too, there is open space. Our mandate is to provide an enriched math/science program that focuses on open-ended problems and to push the boundaries of freedom that we allow our students. It is interesting that on our staff of twenty-three teachers, four of us grew up on farms, two others worked first in outdoor educational settings, and four grew up in small towns in Alberta or British Columbia. The chairwoman of our school board and one of our superintendents also grew up rural and taught first in small towns. For some of us, the specialization of the school is what drew us away from our rural or small-town roots. Most had already found their way to the city before joining our staff, but it is interesting nonetheless that a school with a focus on problem-based learning draws so heavily on people with outdoor experience.

Inquiry-Based Learning

If I were to take my job in Hays back today, I could find better ways around the dilemmas I faced as a new teacher. In many ways, though, my time in Hays provided the freedom I needed to start developing those methods. Unusual circumstances can open doors to unconventional solutions, providing much more room to experiment than a situation where the apparent success of "tried and true" methods have become entrenched pathways from which people are afraid to deviate. If this were explicitly stated as a dangling carrot, it could entice people with fresh vision, eager to explore new ideas and solutions, to rural areas. Freedom was certainly one of the factors that encouraged me to stay in Hays as long as I did, even though I was too busy hiding my inadequacies to feel that freedom for the first two or three years. Furthermore, I know that I left before I had adequately honed my methods to resolve the difficulties I faced in trying to coordinate activities for my multi-graded Junior High class, particularly in math. Perhaps even more significantly, when I left, everything I had figured out went with me. I *was* the Middle School math department and I *was* Middle School science department. I hadn't worked closely with anybody: There was nobody to work with!

Open-ended problems that address deeper mathematical concepts and transcend the boundaries of grade-level curriculum expectations would have made my life much easier and would have allowed me to provide a much richer math program, one not fragmented by running from grade to grade. In the context of real problems, the curricular breakdowns often seem artificial. My Grade Five class is currently studying calendars. We started with the seemingly innocent question of why we need to change the calendar every year, which led to an analysis of the differences between calendars

from year to year and the many patterns inherent in these differences. Is there a pattern in the days of the week upon which our birthdays fall? Why does the pattern seem to go up by one day a year, then suddenly jump two days (e.g. Saturday, Sunday, Monday, Wednesday)? If three hundred sixty-five days divided into groups of seven weeks has a remainder of one that bumps our birthdays up a day each year, why not use a number that divides evenly into three hundred sixty five? Is there such a number? How could we find it (the use of division was obvious to very few students)? Why do we have a leap year? Our discussion of leap years led to an investigation of historical calendars and how they would drift off from the seasons. The students developed spreadsheets to determine how long it would take various calendars to drift off from the seasons. Subtracting the number of days that have lapsed according to the actual time it takes the earth to orbit the sun from the number of days that have lapsed on the calendar sometimes yields positive numbers and other times negative. Why? Why do we often say there are three hundred sixty five and a quarter days in a year when calendars have three years with three hundred sixty five days followed by one year of three hundred sixty six (a good introduction to the concept of the mean)? Why do we need to worry about the long line of decimals in the actual time it takes the earth to orbit the sun (365.2421896698 days)? How can we compare decimal numbers? Could you ever add enough nines to the end of 1.999… to reach two? How can you lock certain values in a spreadsheet (like the number of days in a year) and allow others to change (like the number of years that have elapsed)? What does it mean when a spreadsheet presents answers like “3.4538E10”? Is it okay when the spreadsheet rounds your answers to the nearest two decimal places?

This project is now finishing its second month. We have covered a wide range of concepts, many of which go far beyond the Grade Five curriculum. For the most advanced students in my class, the seemingly simple question of whether you could ever add enough nines to the end of 1.999… to reach two led to a very intense debate about the meaning of infinity and even engaged the brilliant mind of a fifth grader who will be completing Grade Nine Math by Christmas. He argued the following (with glasses perched stereotypically on the end of his nose and wagging his index finger for emphasis):

$1/9 = 0.111\ldots$ ("Do you agree?")

$1/9 \times 9 = 0.111\ldots \times 9$ ("Correct?")

$\therefore\ 1 = 0.999\ldots$

It seemed infallible, but we were all looking for loopholes in his argument. He went home that night and did some research on the Internet. He returned the following day with more fuel for his argument:

Let $x = 0.999\ldots$

Then $10x = 9.999\ldots$

$10x - x = 9.999\ldots - 0.999\ldots$

$9x = 9$

$x = 1$

I, along with a small group of students in the class and a larger group of student teachers working in the school, struggled in vain to prove him wrong. It was news to all of us that 0.999… is, in fact, equal to one. Meanwhile, the other students were debating more elementary concepts relating to the repeating nines.

To reiterate, all of this stemmed from the simple question of why we change our calendars each year. The kids needed to understand many rudimentary concepts to answer the bigger question, and the open-endedness of the main problem and the many problems embedded within provided access points for students of many different ability levels to partake in meaningful ways. Simply working through questions such as these does not necessarily ensure competence and fluency in the basic skills required at a particular grade level, but such problems do provide a good way to put basic concepts in context. In context, the kids learn not only how to apply skills to worksheets, but when and why those skills are applicable.

If during my time in Hays I had been less consumed with developing mark keys for three separate math classes, I may have learned to see my surroundings with mathematical eyes. If I could have trusted that the rich problems that abounded all around me would have indeed covered the curriculum (and probably gone far beyond), I would have been able to capitalize on them: What is the optimum type / amount of food to feed your 4-H calf to maximize rate of gain for the best profit margin? How many calves would we need to consider for a fair sample? How much variation is due to the calf and how much is due to the feed? Does implanting cattle make a significant difference in their rate of gain? How can you program a pivot to cover the maximum area of cropland? How much water should you use to properly irrigate your crop? How can you calculate the belt length necessary to replace the one that broke in the combine? What price of wheat do you need to break even when you sell your crop? The list goes could go on almost indefinitely. Problems such as these could have provided excellent springboards (like the calendar problem) to motivate kids both to embrace the utility of

mathematics and to think much more deeply about mathematics. I can only guess how many spin-offs they may have taken. Many students are very engaged in the business of farming from a young age, and problems like these (if chosen at relevant moments and properly put in context to ensure buy-in) could have been relevant to them in the moment, not just things to learn so they could use them after they grew up. I think it is important to emphasize that it is current relevance to the children that would have made these problems valuable, not the potential utility of those *particular* problems in their adult lives. I don't think I needed to teach agricultural mathematics, but using an agricultural context may have made the mathematics relevant.

It may also have been useful to find problems that fit the oil industry context and to consider potential gender differences between rural boys and girls. Not all families today have roles divided as clearly as they were in my family, but differences still exist. Problems aimed at debunking false advertising and money-making scams are likely relevant regardless of location. For example, a problem such as "Why don't chain letters work?" is rich in mathematical connections and provides an excellent basis for evaluating the many pyramid-based marketing schemes that most kids will likely face at some point in their lives. The key point in all of these examples is current relevance. Although an established collection of such problems provides useful starting points for mathematical inquiry, it is important to listen to each year's individual voices and to seek out *timely* problems that are meaningful *in the moment*. Children want to contribute to the world they live in, not practice for the world in which they will one day be considered "real." If a problem is truly relevant to even one student in the classroom, I've often found that the others can find meaning just in helping them out; the problem serves a purpose that goes

beyond something to hand in for a mark. In Hays, I would have had the added benefit of teaching the same students year after year, which would have allowed me to follow the kids deeply into whatever was relevant, then pick up other threads if not later in the year, then in the following year. This, in turn, reminds of the importance and the difficulty of keeping teachers in rural areas for more than one or two years at a time.

At the end of my first year in Hays, I decided against the school division's multiple choice math exams for Grades Seven and Eight. I put together my own exam based on the program of studies, and the entire test was made up of short-answer-and-show-your-work questions. I was shocked that even my top students performed poorly. Eventually I realized that they probably would have done fine on the multiple-choice tests, which led me to question whether they were really just a guise to justify the reign of superficial knowledge. I'm still facing this battle today, but at least now I expect it and enter the fray emotionally and mentally prepared. As my Grade Fives debated the 1.999… problem over the course of three forty-minute classes, their arguments and questions revealed great depths in their thinking but also large gaps in their understanding. Even after they seemed to understand that each nine that was added would be one small piece short of reaching the amount needed to bump all the other nines up like dominoes until the one finally traded to form two, they did not immediately see the connection between that and comparing the size of two decimal numbers that did not include 9s: Until challenged to apply what they had just learned, many of them still said that 3.5 is smaller than 3.47. I am confident that many of them will still, until challenged to make their methods consistent with what they already know, assert that 3.2 + 3.35 = 3.37. If I simply taught each procedure individually then gave the students sheets of

problems that reflected what I had just taught them, outside appearances would suggest that they had mastered the concepts. But their misunderstandings come to light in their conversations and in their attempts to apply previous knowledge.

Although I learned a great deal about teaching while I was in Hays, the teacher who followed me started from scratch. Of course, she was a different person with a different approach, and it wouldn't have made sense to just transfer everything I had developed over to her. Besides, much of what I had developed was a philosophy and an approach, not a set of lesson plans. Nevertheless, when two or more people work together on something and their methods change and evolve together over time, and when they can initiate new teachers into an existing yet dynamic framework, greater program continuity is possible. The new teachers add themselves to the mix, but at least there is a starting point from which they may jump. I see this at the school where I'm at now, but it was not possible with a single-person Junior High Math/Science department. Although this issue is likely amplified in rural schools, it is perennial in the teaching profession, just as it is in the broader disciplines of math and science. If every generation of mathematicians and scientists had to rediscover all of the knowledge that took thousands of years to uncover, our collective understanding would never progress. But we can't be too attached to old ideas, either. Richard Feynman's thoughts on the nature of science seem very applicable to teaching practice:

> Finally, a man cannot live beyond the grave. Each generation that discovers something from its experience must pass that on, but it must pass that on with a delicate balance of respect and disrespect,

> so that the race (now that it is aware of the disease* to which it is liable) does not inflict its errors too rigidly on its youth, but it does pass on the accumulated wisdom, plus the wisdom that it may not be wisdom.
>
> It is necessary to teach both to accept and to reject the past with a kind of balance that takes considerable skill. Science alone of all the subjects contains within itself the lesson of the danger of belief in the infallibility of the greatest teachers off the preceding generation. (1999, p. 188)

I don't see easy answers to this dilemma, but awareness of the issue is certainly a start, and it is a start that provides deeper insight into the nature of the disciplines that we teach. At the Calgary Science School where I currently teach, we seem each year to move closer to the balance where our new staff feel supported in being initiated into our mission, yet free to help define its fluid boundaries. We are very conscious of the danger of finding a way we call *the* way and thereby killing the living entity that is the true lifeblood of our school. It seems to me that this is particularly important in a place with high rates of teacher turnover.

* The "disease" is to blindly accept the wisdom of preceding "experts."

Ecology

The plight of education in rural Alberta is a reflection of a much broader issue. As increased mechanization reduces the populations of rural areas, many tiny grocery stores, coffee shops, and community centers are closing alongside the schools. I watch with sadness as I see a wonderful way of life crumble away, but I am always seeking ways to share the gifts of that life with students who today often don't even have rural grandparents they can visit. Understanding nature's cycles is part of life when you grow up in the country; you are immersed in the world that sustains you, and you know that grasshoppers, hailstorms, and mad cows directly affect the nation's food supply in ways that are hidden by the bright, cheery aisles of the grocery stores. You know that if you want the land to provide, you have to care for it. Whether we know it or not, we all have roots in the country, and I strongly believe that awareness of these roots is the key to nurturing them.

The late Richard Feynman (cited earlier on finding a balance between acceptance and skepticism) was a brilliant and inspiring Nobel Laureate physicist from Caltech. He had the following to say about food production:

> ...if energy in the far future can be supplied freely and easily by physics, then it is a matter of mere chemistry to put together the atoms in such a way as to produce food, from energy that the atoms have conserved, so that you can produce as much food as there are waste products from human beings; and there is therefore a conservation of material and no food problem. (2000, p. 100)

Something tells me that this purely mathematical input/output model must break down somewhere in the real world. In defense of the math, I guess it might be more accurate to say that some key factors were left out of the equation. What happens when all of Earth's atoms, save those that constitute our bodies, through mere chemistry have been appropriated for human food and we're still reproducing? What happens when the waste from one human must feed two more? Contrast this with ecologist David Suzuki's views. He compares human population growth to bacteria in a test tube: Starting with one bacterium that doubles every minute, the test tube is full after one hour. He poses two key questions about the test tube: (1) When is the tube half full? (and a quarter full and an eighth full) and (2) How much extra time would another full test tube allow? The first question sparks a delightful debate amongst fifth graders (most of whom insist that the tube is half full after half an hour), provides a wonderful opportunity to investigate large numbers and scientific notation, provides a good reason to enlist the use of a simple spreadsheet to graph and further interpret the situation. The larger lesson requires some experience in life to fully appreciate. If you've seen weeds overtake your garden or bred rabbits in the chicken coop, you have a much more solid basis for understanding the impact of exponential growth on population. Even if you could miraculously turn rabbit dung into instant food rather than waiting for it to decompose into soil that could support new plants, the new generation would quickly outstrip the new plants and starvation or an alternative form of population control would be needed to restore the balance.

On my way home from work the other day, I saw a bumper sticker that said, "Compost Happens." It reminded me of the time I took one of my friends from

university to the farm for the weekend. We were walking across the yard as she finished her banana and asked me in what sounded to me like a morally superior tone, “Do you compost?” As the smell of manure wafted over from the corral and a rooster crowed from the pen where he was likely eating the leftovers and scraps from last night’s meal, I smiled, said yes, and in an equally superior manner that I’m still a little embarrassed to recall, took her banana peel and tossed it into the dirt beneath the caragana hedge. A colleague with whom I shared this story explained to me the other day that she had found an interesting rationale for compost: A compost heap accelerates the process of decomposition. I guess it does. To me, this is a striking example of how fast-paced and consumptive our society has become. We even have to nurture the bacteria and mold for them to keep up with the portion of our waste that is biodegradable.

In many ways, we’ve come a long way from our roots. So have our math and science programs. As a society, it seems we often see them as esoteric disciplines that only the brightest minds can understand. We forget that they are tools invented to describe the world we live in. Part of the problem is that the world we live in is increasingly removed from concrete experience. The more time children spend watching television, playing GameBoys, , and surfing the Net, the less time they spend building forts, diverting ditch water, tracking wild animals, or planting gardens. When even play becomes abstract, whence come the concrete experiences upon which to build abstract understandings? This is not to say that the city offers nothing in the way of concrete experience. But it does seem to me that it must be more consciously sought and actively nurtured.

Sometimes, rural experiences are a little too concrete for comfort. One day in my Grade 3/4 Science class, we were discussing pollination. I told them that pollen is really plant sperm, received the usual groans from a group of children who knew little more than that sperm had something to do with boys and sex, and proceeded with an explanation of fertilization. At this point, one little girl raised her hand and asked how bulls get sperm into cows. She knew that the cow jumped on the back end of the cow, but she wasn't exactly sure how the sperm got transferred. I wasn't their health teacher, and I doubted whether the permission forms necessary to teach sex ed. had yet been collected. I wasn't sure how far this conversation should go. Somehow, though, the debate turned from exactly how the sperm gets into the cow into how different animals couple. Before I knew it, one of my Grade Three girls was at the front of the room on her hands and knees pretending to be a female llama and pointing around behind her to indicate where the male would be positioned if he were mating with her. I can't remember how we wrapped this up or turned the discussion back to plants, but the event reminds me that in the country, life is right in front of your face. Compost happens. Sex happens. Shit really DOES happen. And they all happen for a reason. When you're pursuing a genuine goal, math is like shit, sex, and compost: It happens. But until we learn to see the world through mathematical eyes, we don't always recognize how pervasive it really is. While I was consumed with creating detailed mark keys that demonstrated all of the proper steps, I missed out on a world of opportunity all around me.

Country life is very practical. In 4-H, we were taught to "learn to do by doing," and I remember reminding my dad many times of this motto when he wanted to clip my

calf or build my gate sign. He was more than willing to let me assume routine chores like feeding and grooming my calves. As I became a teenager, my parents often lamented the fact that I "had to learn everything the hard way." At this point, their impulse was protective and necessary, but I think we take away too much of learning the hard way. Real learning is often the hard way. That's what makes it interesting. In their inspiring book, *The Geography of Childhood*, authors Gary Paul Nabhan and Stephen Trimble reflect on a conversation with a ranch mother:

> Jordan also pointed out how ranch children shoulder responsibility early. At eight or nine, ranch children work alone. In round-ups, they are assigned a particular ridge; if they find no cows there, what do they do? How far off the ridge do they go? In looking at a distant field, they may see a cow lying down. Is it sick or just sleeping? Does it need doctoring? An animal may die if they do not make the right decision. Says Jordan, "If they live in a supportive family where the fact that they made a decision is applauded even when the outcome isn't perfect they grow into decisive and confident adults. (1994, p. 127)

These children are given a task, and they are responsible (with support and guidance) to figure out what steps they need to initiate to make it happen. Assessment depends on success at the task, and they care about the results. The critical role of the supportive family applauding efforts even when the children don't succeed is critical to the ultimate goal of developing successful and confident adults, and it essential that we ask ourselves how we can bring this attitude into our classroom families. Nurturing these attitudes is not the exclusive domain of country folk. But a lifestyle that provides ready

opportunity for children to have real and meaningful roles can remind all of us, as educators, of the importance of acknowledging that children are real people with real contributions to make. There is no sense in lamenting a vanishing way of life, but I believe we would be wise to heed some of the lessons of a culture where children are given this type of opportunity and responsibility.

It is here that I see a very special opportunity for rural educators. We need to build bridges. I have in my mind the seeds of a week long "Farm School" to help kids in the city understand the source of their food. If they could spend even one week caring for livestock, tending crops, tending the gardens, and preserving winter food stocks, I don't think they would see the aisles of the grocery store in the same light. An investigation of the local prairie would remind them that before agriculture, needs for food and shelter were met in very different ways. I think if all students were to partake in such an adventure, they would gain a much deeper appreciation of the importance of both agriculture and ecology to their lives. This could also provide a rich context for many valuable math, science, and history lessons. Local kids could even act as hosts and perhaps later visit their city friends for a week of "City School." If this were taken on a broad-based initiative, it could also help to broaden the professional network available to rural teachers.

My family still owns and operates our farm, and my brother is now fully involved. I get home when I can, but it's much different to be a visitor than one who is part of the whole lifestyle and culture of the country. Nose Hill, Canada's largest urban, natural area park with 2,700 acres of grassland, is where I often go to get away from the city. Sometimes, I hope that I will find my way back to rural Alberta, but it doesn't look likely

in the near future that my husband and I will both find ways to make a living outside of the city. I'm no longer even sure if I'd be happy there. When I stand in the middle of Nose Hill, a twenty-minute bike ride from my house, I am surrounded by the prairies that I love. I used to resent the skyline visible on the southern horizon, but I am learning to appreciate deeply the first place beyond the temporary halls of university that has provided me with a community of friends and colleagues from whom I would be very sad to distance myself. But I continue to ally myself with my rural roots, and I hope that I can share my own experience in a meaningful way with the ever-growing number of children who cannot know their own rural roots first-hand.

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