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Personal Health – Personalized Science: A Phenomenological Approach

Abstract

Since the 1950s, originating with and driven by the Sputnik shock, there have been tremendous efforts to improve science education. Over the past two decades, the initial focus on pre-specified science content organized in scope and sequence has decreased, at least among many science education researchers, in favor of socio-scientific issues as context within which any relevant scientific concept is allowed to emerge. Yet even this social turn does not appear to make much difference, as scores of students continue to be turned off in/by science. In this contribution, based on a first-person investigation, I suggest why and under which condition health and environment may constitute suitable contexts for (also) teaching science. The proposal rides on the phenomenological insight of a first body, in which we experience life – pain, suffering, affliction – prior to any consciousness. In this approach, science education becomes personally relevant because, hyperbolically expressed, it really "goes under the skin." I conclude that more than science content and approach, (science) educators need to reconsider the effective science curriculum in terms of it affects students, physically and emotionally (affectively).

Keywords health; environment; science education; first-person method; pathic body

Relevance and Science Education: Obesity as a Case of Individual and Collective Health Concern

The purpose of this contribution is to provide an argument, suitably exemplified with a first-person investigation, for teaching science by accessing the interrelation of human and environmental health through personal health, consistent with an apparent "broad consensus" that these issues should be featured more prominently in science education (West, 2012; Zeyer and Kyburz-Graber, 2012). At this point in time, as an analysis of PISA 2006 data show, health issues are relatively more preferred science topics in non-European than in European/Western countries (Olsen and Lie, 2011). Health, because it is related to our *pathic* bodies, is closer to us than anything we may access via (discursive, visual) representation that predominate in going theories of knowing (Roth, 2011); our personal health, however, cannot be understood independent of environmental health (Science and Environmental Health Network, 2002). All too often, however, educators are concerned predominantly with the discursive and measurable aspects of some health issue –e.g., related to respiratory illness (Lee, 2008) or genetic disease (van Eijck, 2010) – rather than with the fact of being affected by genetic disease and respiratory illness. However, precisely because the interface of personal and environmental health is so close to us, science education has the capacity to bypass discursive mediation and, by means of the environment | health connection, really "get under the skin." Approaching science education through personal/environmental health, therefore, promises long-lasting, intimate forms of understanding science, especially to some pressing issues that we may denote to constitute the current health crisis. Thus, despite increasing levels of schooling

over the past century, health issues that could be prevented actually have increased. For example,

> [i]n 2010, just over a quarter of adults (26 per cent of both men and women aged 16 or over) in England were classified as obese (BMI 30kg/m^2 or over). For the same period, around three in ten boys and girls (aged 2 to 15) were classed as either overweight or obese (31 per cent and 29 per cent respectively).
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> In 2010, 41 per cent of respondents (aged 2+) said they made walks of 20 minutes or more at least 3 times a week and an additional 23 per cent said they did so at least once or twice a week in Great Britain (GB). However, 20 per cent of respondents reported that they took walks of at least 20 minutes "less than once a year or never" in GB. (NHS, 2012)

A famous Latin proverb states, *Non scholae sed vitae discimus* ("We do not learn for school but for life"). The preceding quotation shows, however, that despite schooling, a large percentage of the population in England is considered obese, a condition correlated with many health immediate and looming health problems. Overweight and obesity is widespread in the US – 68.8% overweight (BMI > 25 kg/m^2), 35.7% obese (BMI > 30 kg/m^2, and 6.3% morbidly obese (BMI > 40 kg/m^2) – and continue to constitute the leading public health problem (Flegal, Carrol, Kit and Ogden, 2012). The same study points out substantial disparities based on race/ethnicity, gender, geographic region, and socio-economic status. These problems begin in childhood, where alarming rates of obesity have been reported among children and youths (Ogden, Kit, Flegal and Carrol, 2012). But there are numerous countries with even higher rates of obesity, with Tonga leading the pack where obesity rates have been reported to lie above 90%.

The costs of overweight and obesity are high not only to the person but also to society as a whole. Severely obese people die 8–10 years earlier than normal, with 30% increase in risk with every 15 kilograms above normal weight (OECD, 2012). Between 1 and 3% of public expenditures are reported in different countries, mounting to 5–10% for countries such as the US. Costs are expected to rise even more when the effects of recent increases in obesity levels come to manifest themselves. There is a health crisis in addition to the environmental crises (pollution, global warming) and, so far, science education has contributed little in preventing these crises. Despite having made it through our science courses over the past several decades, public (politicians) and private decision makers (industry) continue to favor processes that harm individual and collective personal and environmental health rather than working towards prevention and solutions. Whereas body weight may be a cultural construct, science comes into play with the biochemistry associated with obesity (Zeyer, 2012).

Even more important, the health problems and illnesses associated with overweight and obesity are *not* (mental, social) constructs: these are lived as afflictions, to which we are subject and subjected, and which we experience *prior to* any conceptualization (e.g., as pain, suffering). These affect us, our bodies and emotions (affects); these are pathic experiences that more profoundly change our lives than their conceptualizations do, which are external to the experience as such. Thus, more than the reasoning and decision-making that are of many science educators' concern (e.g., Lee, 2012), the pathic experience of something befalling us – acne, hearing loss, heart problems – should be the locus of

grounding a post-constructivist science education. There is nothing constructed about the shortness of breath, fatigue in the legs, or profusion of sweat when an overweight or obese person walks up (attempts to walk up) a flight of stairs. S/he is living and living with overweight, obesity, and related effects prior to knowing these *as* breathing difficulties, fatigue, or profusion; s/he is living with the effects and affects prior to "the apportioning of more blame, guilt, shame, and hopelessness on fat children and their parents" (O'Dea, 2010, p. 36). In making thematic the knowing related to lived afflictions, this study radically departs from any other theoretical frame that exists in science education, which are concerned with understanding as (individual, social) construction. It does so by introducing to epistemological considerations a passivity that is more radical than any passivity we might intend by standing back or withholding. This passivity is more passive than being affected by something from outside. It is the passivity of the body that affects itself such that it even is integral to activity (Husserl, 1939). In this paper, I suggest that a science education endeavor anchored in the afflicted – rather than the felt or known about – body has an effect and is effective because it literally affects and is affective.

The proposal not only challenges current epistemologies but also current school science practices. Thus, the effect and effectiveness of a curriculum no longer can be established by means of (international) assessments of symbolic mastery of science on decontextualized tasks in paper-and-pencil and other formats – even though effective interventions, such as in the case of a Swedish study concerning auditory health, may indeed lead to a changing way of life *and* changes measurable by means of questionnaires (West, 2012). Rather, the effect and effectiveness of the curriculum has to be evaluated in terms of the real changes it has brought to the health and well being of each individual student and the (societal, material) world s/he inhabits as a whole (Dillon, 2012). The kind of effectiveness I am thinking about was seen in a study of the role several intervention strategies relevant in the context of this special issue that were successful in implementing changes related to body weight among youths in Tonga (Fotu, Moodie, Mavoa, Pomana, Schultz and Swiburn, 2011). The project strived to "empower and strengthen the leadership skills of both individual and groups around championing healthy lifestyle strategies." The study reports that "there were many concrete examples of students being empowered, as illustrated by their active participation in workshops, and their subsequent demonstration of newly acquired skills in initiating and conducting activities, preparing funding applications, and approaching stakeholders." Students became role models, who motivated others to make changes that promoted better health in the school, at home, and in the community. Associated agricultural programs allowed communities to grow vegetables to supplement their traditional food staples. Thus, there is evidence that a school-based intervention, in which science education could likely play an integral part, can be successful. However, we still have to understand, conceptually and theoretically, why such programs may have greater potential for contextualizing science teaching than other programs, even those focusing on socio-scientific issues. I suggest in this article that environment, health, and environmental health get at the pathic experience that arises from our affected bodies, and therefore touch learners more than any mediated access to this or that issue that is currently covered in the science curriculum.

Science | Environment | Health

In this section, I contextualize the present argument and investigation in two ways: (a) by considering the nature and roles of "drivers" in science education and (b) the relation between knowing and the known.

A New Driver for Science Education?

Precisely one decade ago, a number of science educators have discussed the nature of the drivers of science education, by and large favoring a displacement of the curriculum from within science to society. The lead article for the debate which expanded over two issues of the *Canadian Journal of Science, Mathematics and Technology Education* argued to change the driver from the unsuccessful focus on scientific content to considering society as the point of departure for rethinking the curriculum in science education (Fensham, 2002). Many responding authors agreed providing specific examples of curriculum that places what now are called socio-scientific issues – e.g., Science-Technology-Society or science-and-citizenship – at the center of curriculum considerations for science (e.g., Aikenhead, 2002; Roth, 2002; Solomon, 2002). The interest in socioscientific issues has increased among science educators and there are, as of February 2013, 126 studies in the Thomson Reuters Web of Knowledge database for the search term "socioscientific issues." However, these studies tend to be concerned with "understanding" (e.g., Kishfe, 2012), "views" (Boon, 2012), "habits of mind" (e.g., Calik and Coll, 2012), or argumentation (e.g., Arvola and Lundegard, 2012; Christenson, Rundgren and Hoglund, 2012; Kishfe, 2012) rather than with the question whether students are truly affected, emotionally, and bring about changes in their lives and conditions. It is therefore hardly surprising if little appears to have changed: the curriculum still is not really getting to the students.

A problem science education has to face – even in those new approaches that appear under the banner of socio-scientific issues (e.g. Byrne, Ideland, Malmberg and Grace, this issue; Nichols and Zeidler, this issue; Rose and Barton, 2012) – concerns the relation between the knower and the known (Roth, 2011). Currently, students only gain, at best, symbolic mastery rather than real mastery – a relation that may be best expressed by analogy with other fields. For example, there is a difference between knowing *about* football (soccer) and knowing to play football, just as there is a difference between knowing about (theory) teaching science and knowing how to teach science (Tobin, 2005). That is, symbolic mastery means that an individual does not get to experience a phenomenon but only talk about it without being affected. A problem with the socio-scientific issue approach may also be an attitude according to which possible effects will affect later generations and others, and, therefore, do not need to be attended to. The problems are not sufficiently personal and can easily be disattended to. Environmental issues, when these are temporally or geographically removed, are less likely to have an impact than those that "hit close to home," in the body, and literally "goes under the skin." A science-as-it-manifests-itself-in-daily-life approach at the intersection of personal and environmental health may serve to ground science education better than any other current approach (e.g., Keselman, Hundal and Smith, 2012).

One study that contributed to the special issue on the drivers for science education suggests including topics such as nutrition and eating habits as important topic (Treagust, 2002) – and for very different reasons, I suggest in this article to pursue this line of thinking consistent with the interest students apparently exhibit for such topics and

associated beliefs that these are both societal challenges and offer interesting job opportunities (e.g., Sjøberg and Schreiner, 2005). Another study suggests expanding the discussion by taking science education beyond schooling (Roth, 2002) – a further issue I discuss as a necessary ingredient to make science education more relevant, in part because it concerns students themselves (West, 2012), in part because, as several authors state, it leads to empowerment in the political arena (Larochelle, 2002; Rose and Barton, 2012; Treagust, 2002).

Moving Towards Relevance: The Relation Between Knowing and the Known

Science educators thought about and have made connections between learning, the body, and relevance. Thus, "hands-on" has become a rallying cry for many, even though schools by and large still teach in traditional ways that favor rote learning. Objects in the natural world are easily shared, because all participants in a learning situation have equal access to it – e.g., a hands-on experiment or science demonstration – these externalities do not really "touch" us but are accessed via representations (e.g., words, images, graphs, and numbers). There are phenomenological reasons why the world, though coming into being through our sensori-motor actions comes to be experienced as separate from us (Roth, 2012). This separation underlies the very split between knowing as it arises from being-in-the-world – i.e., knowing one's way around the world (knowing-*how*, knowing-*for*) – and knowing-*about* the world (knowing-*that*). The body plays a role in conceptual understanding that science educators have not yet theorized, but which has emerged in the context of mathematics education: incarnation and the living body (Roth, 2010). Health issues are of particular import to learning, because what we experience in our living bodies and as incarnate beings – e.g., pain, suffering – is inaccessible to another person in contrast to objects and phenomena (objectified forms) in the environment. At the same time, precisely because it *affects* us – *touches us* physically and emotionally – health *first* is a pathic before it can be a mental experience. The experience of a liver or heart transplant fundamentally changes the ways in which we understand and relate to the environment, as can be seen from the accounts of philosophers (Nancy, 2000) and natural scientists alike (Varela, 2001b).

There is confusion about what "embodied knowing" means because in the literature there tend to be only two bodies that are made thematic in the distinction of knower and known. Both of these bodies related to forms of knowing that already is symbolic (philosophers use the technical term *transcendent*) and the relationship of these bodies need to be understood for arriving at an appropriate epistemology – one required to make the kind of link between environment, health, and science that I argue for in this paper. To understand the role of the pathic in our experience, and, therefore, the role of the pathic in *all* of our knowledge, we need to understand the triple nature of the human body.

First, there is the living, organic, pathic body or flesh (*Leib*, *la chair*), which, in and as living phenomenon is inaccessible (Henry, 2000). Although inaccessible, this living, *experiencing* body, which knows *itself* rather than *about* itself, never the less the seat of the most fundamental aspects of knowing, including the movements of our vocal tracts producing the sounds of language, saccadic movements of the eyes that underlie the phenomenalization of stimuli into real objects seen, or the knowing ways in which athletes act appropriately at the right instant without having to spend a single thought (e.g., Maine de Biran, 1841; Sheets-Johnstone, 2011). It is that body that knows prior to any schemata,

prior to any thought or discourse. This first body, which exists prior to any intention (will), is locus of pathos, suffering and joy, where *pathos* is understood as "a transcendental and pure affectivity in which everything experiencing itself finds its concrete, phenomenological actualization" (Henry, 1999, p. 353). It is here that we are touched (*my* pain never can be experienced by someone else), where we are directly and immediately (i.e., without mediation by language) affected physically and emotionally. It is where something is happening to me before any intellectual grasp – technically speaking, pre-noetically – and where we ask "What is happening to me?" and "Why is this happening to me?" It is precisely for this reason that a health-related issues address students in a new way: not mediated via language, and, therefore, via "interest," but directly in their flesh and blood. The adjectives "unmediated" and "immediate" render justice to the fact that we only live but never access through discourse this "real biological [i.e., living] phenomenon" as some believe it to be possible (e.g., Faria, Freire, Baptista and Galvão, this issue); talk and argumentation (e.g., as in Grooms, this issue) alone will never get us to live this experience. Talking and writing *about* the experience of extreme passivity *is not* this passivity itself, the living experience thereof. To write/talk about something, it already has to stand out and, therefore, has to be external to the phenomenon. We may talk about it but will not truly understand, not be able to have empathy, without having had ourselves such an experience *in flesh*.

Second, there is the *experienced*, transcendental body, the one we experience subjectively in flesh and blood, such as when feel something *as* pain in a muscle. Thus, when I told my health practitioners that I was fatigued, I was only talking about the way in which something felt and in terms of a language I shared with them. This transcendental body – transcendental because it stands out against a background and has become a feeling – though accessible subjectively, is so only by means of objectively shared language. My pain itself, though experientially real, is always *my* pain and nobody else can feel it; but through language it becomes something shared with others *as* pain (Henry, 2000). This pain, I (have to) live and live with prior to and independent of any language.

Third, there is the constituted body, that is, my body as body among bodies as it is accessible to others, doctors, scientists, nurses, and the like. This is the objective and objectified body, as it appears in medical tests, imaging, and discourse. The second and third ways of the body also have been referred to as the *constituting* (sensori-motor) and *constituted* (objective) body (Merleau-Ponty, 1964). Both are intentional, because the have an object: the health practitioners' and my talk about pain is talk about *something* (object) toward which our talk and actions are oriented.

In this phenomenological approach, therefore, a distinction is made between the living body (first), the lived, felt body (second), and the objective body as it appears in science (third body). The approach to science education advocated here places primacy on the first body, without which there could not be any sense, because it is here that the sense of the body constitutes the body of sense (Nancy, 2006). The current science education literature concerns only the second and third bodies – i.e., that which can be talked about. The approach presented in this paper radically departs from any other existing one in that it orients us to the first body, the only one in which we are affected and immediately suffer afflictions prior to any conceptualization. Together, then, the *three* bodies are required for authentic discourse, which *carnally* knows what it is talking about. This is so because "I cannot identify the behavior of the other as choleric without adopting at first an exterior

point of view over my own affects" (Franck, 1981, p. 157). That is, there are carnal manifestations (experiencing body), which I come to identify as *something* (experienced body) only because of a language that has a place in an objective and objectified world (constituted body). Only under the condition of the three bodies can I truly understand the *living* manifestation of another *as* "choleric." It is only in the first body that pain and other passions arrive; it is only through the experience of the third body, which is part of the external world, that I can share descriptions with others that then can be used to make, in the second body, a relation between my flesh and my constituted body as an objectified entity. Sympathy and empathy require the same three bodies, which provide access to the same pathic experiences and the same language.

Method

In this article, I suggest why and under what conditions health and environment may be constitute suitable context in which students will access and, therefore, learn science (among other things). Because, as stated, we learn for life rather than for school, environment | health as something we *live* and are subject/ed to *in our first bodies* by participating in the real world may inform us better than formalized disciplinary knowledge about what science to teach and how to do it. I therefore exemplify my argument with materials from a personal health issue – a ten-year bout of chronic fatigue the cause of which could never be pinned down – as a basis for reflecting upon the role of scientific knowledge and literacy (my own, the doctors, the medical system) in dealing with a sometimes traumatic and debilitating affliction. In so doing, I employ a rigorous first-person method that is rather exceptional in science education even though (cognitive) scientists (e.g., Varela, 2001a) and mathematicians (e.g., Husserl, 1976) alike have used for understanding fundamentals of human experience and knowing (see also Depraz, Varela and Vermersch, 2002).

The (social) sciences, just as everyday life, are beleaguered by pre-constructions and "natural attitudes" (Bourdieu, 1992). Fundamental to a rigorous first-person method is bracketing of scientific and mundane pre-constructions (presuppositions) alike. This occurs in a process called "□*πoχή*"[*epoché,* also spelled *epokhè* or *epoche*]" (Husserl, 1976, p. 65), which is designed to make the pre-constructions inoperative. Epoché involves three stages:

> – *Suspending* your "realist" prejudice that what appears to you is truly the state of the world; this is the only way you can change the way you pay attention to your own lived experience; in other words, you must break with the "natural attitude."
> – *Redirecting* your attention from the "exterior" to the "interior."
> – *Letting-go or accepting* your experience. (Depraz et al., 2002, p. 25)

Readers are directed elsewhere for examples of detailed investigations pertinent to content and process of science education (e.g., Roth, 2006, 2011) and descriptions of the method (e.g., Roth, 2012, especially chapter 9 "Crises and Suffering as Sources of Learning"). The method is rigorous because epoché strips anything subjective from the description of the phenomena that often characterizes educational studies that claim to be phenomenologically grounded but really are concerned with "feelings," which are related

to the second form of the body described in third-person terms. The point of first-person method as an approach is to generate rigorous data and analyses that may serve as the referents for the natural and psychological sciences investigating relevant experiences.

The data for this study derive from the notes I have kept in the course of a decade of dealing with a debilitating chronic fatigue and the experience with the official and alternative medical systems (see also Roth, 2009). In the process, I kept notes, photographed salient aspects (e.g., apparatus, instruments, and traces an investigation left on my body), collected relevant scientific studies and information from websites featuring scientific and alternative medical approaches. The point of the data and analysis is not how I (or any other first-person researcher) felt but to understand the structure of phenomena and the processes of their phenomenalization. In this endeavor, all natural and scientific explanations – which, in fact, are grounded in the former (see also Reeve, Bricker and Bell, this issue) – are ruled out and therefore bracketed: "I *do not make any use* of their validity . . . even if they are completely evident" (Husserl, 1976, p. 65, my translation).

A Mysterious Illness and Attempts at Diagnosing and Efforts at Treating it

"And the word was made flesh," John, 1:14

The following account of a mysterious illness and the protracted search for its causes exhibits multiple, dialectical tensions related to a very personal experience in its encounter with science | environment | health. Being unintended, the illness is experienced in and by the pathic (passive) *first* body, but comes to be known through formal biomedical, alternative medical, and other forms of (personal, vernacular) knowledge (third body). There is therefore both a link and a disjunction between the living and experiencing body (of the learner), the lived, *second* body we can talk about, and any knowledge that we may have about it as an object (third body). But it was in my first body that the scientific word, to paraphrase the biblical reference, "was made flesh": related to affectation and affect.

An Illness in Flesh and Blood

One day in the summer of 2002 – having just arrived in my office to get ready for teaching a graduate class that afternoon – "I" was all of a sudden struck by an extreme fatigue. In fact, there was something happening to me *before* I could name it "fatigue"; and this something was not coming from somewhere but from my body itself. What phenomenalized itself *as* fatigue requires a self-affection of the (first) body such that it can stand out (in and as the second body) and be named and investigated by the health practitioners (third body). Moreover, there was not even an "I" who felt; there was but an intense sensation that I came to name "fatigue." Something unnamable advened to me, making me an advenant and patient (Roth, 2013a). It was so intense that I could not decide what to do next. There was passivity more passive than any passive behavior I could decide upon. And then there was abandonment. I woke up some time later on the floor right at the place where I knew to have stood last. A similar incidence occurred a few days later at home, where "I" could not even decide to take the few steps to the couch only 3 meters from me to rest or sleep but dropped where I was: in the middle of the kitchen and on the tiled floor. The experience of passivity was so radical in a double sense: (a) what was

happening to me was not the result of intent but of pure passion and (b) "I" did not even have a choice of wanting to do something or not. I immediately understood that I was coming to know something that could only be grasped in and through being affected (Roth, 2011). Over the next few weeks, I found in and through my body that the "fatigue" was paired with difficulty to recover from exercise. A day with a bicycle tour (short compared to what I had been doing before) was followed by a day when the legs felt tired, and another day when I could hardly ride at all, requiring a resting day before I could start with light exercise. Using the stairs from the lower to the upper level of the house became difficult, as the legs felt so tired. Such fatigue we do not understand until we have really lived it. Over the decade that followed – driven by and deriving in a certain way energy from my pain and suffering that operated at and constituted the core of my being – I engaged with and came to know a tremendous amount of formal scientific (biomedical), alternative, and vernacular (folk) medical knowledge.

In the Standard Medical System – Take 1

My physician, worried that I might not get sufficient sleep, prescribed a sleeping aid. Although I tend to be skeptical about medication, I was willing to try but abandoned immediately when I experienced the stated side effects – including frightening nightmares and extreme sweating – during the first couple of times. Whereas for him, it was a symbolic mastery of symptoms and an act of writing a prescription, I was really affected, physically and emotionally. The physician was also concerned that a chronic sinusitis was keeping me from breathing well and prescribed a steroid drug, which only dealt with the symptoms rather than the causes. He said that someone eating as healthy as I do *could not be* ill and that I was better in shape than 95% or more of men my age. My father-in-law, a physician in France, suggested on the phone that the problem might not at all be regular anemia but low storage iron (ferritin) levels. Tests revealed just that. My physician recommended supplementation. A follow-up test 3 months later revealed little change – my levels still were subnormal. He recommended doubling the dose: A follow-up test 2 months later showed that I was just below the threshold. He recommended tripling the normal dose of supplementation. Another three months later, the levels had crept just into the normal range. During this time, no other options were pursued as the physician wanted to eliminate "one possible cause at a time." My fatigue, however, stayed with me.

The allergist conducted a standard test for about 32 different substances; the test was positive for dust and mites. He recommended special bed sheets and other (expensive) things that I could buy. The specialist was relatively uninterested in the fact that I had been proactive by removing all wall-to-wall carpets and runners in two houses I owned suspecting (my vernacular knowledge) that I was allergic to dust, which was born out by the fact that a chronic sinusitis had diminished. I had already experienced the relationships between the environment and personal health when, for example, my 40-year chronic sinusitis problems increase and become more intense when I live in humid climates. Symptomatically, when the conditions are very dry, such as in desert climates or on an airplane, I experience no obstruction of the nasal passages whatsoever.

The rheumatologist conducted a number of tests and ordered X-rays. On the day I saw him to receive the results, I had particularly strong pains in my joints, especially the glenohumeral (upper arm/shoulder) and knee joints (femur/tibia, femur/patella). He said that I have nothing and that there is nothing wrong with me. At the same time, I did not

recognize myself, the real me, in the X-rays that he had asked to be taken of my joints. I suddenly realized that he was not looking at *me* but at an X-ray that made present *an externalized aspect* of me, from which the very living experience of pain had been stripped. Not having access to this experience – singularized in and through my body – he could only rely on what the mediated access showed: nothing, because what there really is had not made it onto his photographic plates.

I underwent repeated neurological testing, and by different neurologists. Having participated in scientific research that measured the propagation of (heat) waves through human oral tissue, I found the tests interesting as the different graphs show lag times in the pulses traveling through left and right leg. The neurologists in my city ultimately decided that there is a high likelihood of a neurodegenerative disease: either a form of multiple sclerosis or, associated with a 5-percent likelihood, amyotrophic lateral sclerosis (ALS or "Lou Gehrig's disease"). Only further testing would disconfirm or confirm this hypothesis. The effect of this diagnosis tremendously *affected* us, emotionally as well as cognitively. Three seemingly interminable months of waiting for admission to the premier specialist in my province followed. My wife and I read up on these illnesses and began considering various options and needs, a ramp to permit wheelchair access. During the examination, the specialist neurologist said that he understood why previous doctors were thinking that I might have ALS but that based on his long experience I did not have this illness.

While discussing these latest results with my family physician, he said that we had now exhausted all avenues and that – because the symptoms persisted – I should perhaps try alternative medicines (health providers).

Alternative Medicine

Stimulated and encouraged by the medical advice, I began to search the Internet on alternative medicine but ultimately relied on recommendations for whom to consult with. The first doctor was a former graduate of my own university (BSc) who had specialized in traditional Chinese medicine (TCM) and also obtained degrees in the relevant medical fields. During the 1-hour intake interview, he made some very quick diagnoses that became the basis for the treatment. Based on the color of my fingernails, he decided that I most likely had vitamin B12 deficiency and he recommended a special product (expensive) that he sold in his practice. This deficiency would have explained the slow uptake of the iron earlier in my peregrinations. Most striking, however, were the final phrases he uttered while I was in the process of leaving, which indicated to me (I realized this only later) that he did not really know what was wrong with me. He said that if the symptoms persisted despite taking the medication he had prescribed, I could return two weeks later for another half-hour visit, during which he could also provide me with a vitamin B12 injection. I did not return even though the symptoms did not abate. I made this decision not to return because I was suspicious of the method: a rapid diagnosis along one dimension without investigation of the person-in-his-setting, no inquiry into my lifestyle, no attempt to understand nutrition, exercise, and the person-environment interactions.

Although I had decided not to seek further help in the alternative medical field, two colleagues – she working in my faculty, he an internationally renowned scientist who often appears on TV – recommended another alternative health provider who apparently had assisted them with what had been a long-term ailment. I gave it another try. Here, the intake interview cost only $25 and led to a list of recommended testing procedures –

which, as I later found out from the secretary, would have come to nearly $800 (to be born by the patient, as the insurances do not cover costs from alternative health providers). I told the secretary that I would consider first, noted some of the tests to be conducted, and then checked out some of the tests.

I had been immediately suspicious when the TCM practitioner expressed astonishment over the fact that I had gold crowns. For me, with graduate work in physical chemistry, the choice had been evident – gold is one of the least reactive materials and much better than the lead-based amalgamate fillings that contribute to heavy metal load in the body. In his opinion, the electrical potential between the crown and the cheek could be problematic to the health of a person. When I told my dentist about these claims, she laughed and confirmed my suspicion that there was no (scientific) evidence that gold crowns were leading to problems, even though websites for alternative (holistic) health do claim allergies to dental materials but generally amalgamates including chronic fatigue, chronic inflammatory changes (rheumatoid arthritis, fibromyalgia, chronic neurological illness). The second test I researched more closely concerned *Candida albicans.* In both regular and alternative health fields, this diploid fungus has been identified as a major concern (e.g., among immuno-compromised patients). Online, I found several questionnaires that are used to identify Candida-related health symptoms and history: all turned out negative. My Internet research confirmed the suspicions that there was little if any evidence that would have warranted the procedures and tests that this alternative health provider recommended.

Self-help and Changing Lifestyle

I had read on the Internet that there were individuals using marihuana to deal with the pain associated with chronic fatigue syndrome. This drug is legal in Canada when prescribed by a health professional and can be accessed through passion clubs upon presenting a prescription. However, in the relevant culture, the officially grown plants are held to be less effective and helpful than the locally (sometimes illegally) grown variants. It was in this alternative culture that I received prepared cookies and seeds. I did grow a some plants, as there are no legal proceedings in the case of small numbers and personal use. I found out in my first try that I did not like the effect of smoking on my lungs, and did not think that it was compatible with my extended physical exercise. I also did not like the rapid effect it had on the mind, which made it impossible to work, even though the pain disappeared as anticipated. I experimented with ways of incorporating it into food materials (cookies). On the Internet, I found out that the active chemical in cannabis, tetrahydrocannabinol (THC), is fat- rather than water-soluble. The recommendations therefore include preparing extractions by placing powdered leaf materials in heated butter prior to using it in cooking. After some experimenting with carefully weighed amounts, I found out the amount to be eaten to ease the pain but not to affect my ability to do my regular work. There was a strange sensation of the pain disappearing and a prickling feeling, like heat, that was rising to the earlobes but leaving the forehead cool. I found out about the temporal lag between the two forms of taking: smoking affects the brain within minutes whereas the effects of ingested THC are noticeable only after several hours. It also constitutes an effective assistance to sleeping, because it led to better (deeper) sleep without any effects noticeable in the morning upon awaking and getting up. I told my physician, who was concerned because of the legal side, but took note in my medical record

that I was responding positively to this form of self-medication.

My continued research on the Internet and in databases of the regular medical literature (e.g., using databases such as Thompson ISI Web of Science) turned up positive study effects of dry sauna on symptoms associated with chronic fatigue syndrome, such as joint pain and muscle aches. In 2006, my wife and I decided to purchase a sauna. Within less than two weeks of daily sauna, the fatigue symptoms were easing and the joint pain was completely gone. I instantly stopped the self-medication with THC.

At the same time, my wife and I decided to go completely organic, in part because of the reports that autoimmune deficiencies may be associated with chronic fatigue syndrome, fibromyalgia, and other chronic illnesses. We expanded the summer-only garden into a permaculture installation and began to grow all vegetables and berries we eat and many of the fruit – a clear attempt to contribute to resilience, "the innate ability of biological systems to protect themselves, received, and heal" (Science and Environmental Health Network, 2002). In the process, I found out about environmental issues, growing conditions, requirements, and about the relative resistance of the plant to pests, allowing them to be grown without pesticides and herbicides. We also became members of an organization that fostered green corridors for wild life to use during their migration.

In the Standard Medical System – Take 2

Although the sauna regime had helped ease the problem, there was now an ebb and flow, with periods where the fatigue-related symptoms all but disappeared and periods characterized by more extensive fatigue. I returned to the physician to ask for assistance, which led to a new cycle of investigations. I first was sent to the neurologist, who conducted the same kinds of tests as before. I also had pulse oximetry, where blood oxygen levels are monitored over night using a clip fixed to a finger. Because of some confusion, neither the physician nor I came to know the result. It turned out afterward that the results were negative (no apparent variations in blood oxygen levels) and would not have warranted the more advanced tests in the sleep clinic.

In the meantime, the neurologist had requested a session in the sleep clinic. Probes were attached to various parts of my body, especially to my head (Figure 1). The technician asked me to sleep in a way that the probes would not come off. As a result, I had to sleep on my back – which led to the most horrible night I had ever experienced, waking up more frequently than I normally do, with nightmares, sweating. I got up in the morning with no resting feeling whatsoever. The thought crossed my mind that the test conditions themselves had contributed to the results. The diagnosis was that there were 20 apnea episodes per hour, where the areal track was obstructed completely (because of a collapse of the structures in the back of the mouth) leading to a stop of breathing until the choked body came up for oxygen; there were 40 such episodes during the REM period of sleep. As before, although I found the (multitude of) graphs interesting, as the processes involved in reading them, I could not see *myself* in that the graphs displayed on the gigantic monitors. My living body had once again become an objectified body. But as a result of his interpretation of the graphs, which did not show the real *me*, he doctor listed three options that would *affect* my life: operation, oral appliance (the U.S. FDA lists many different forms), and a device referred to as CPAP (continuous positive airway pressure). He advised against the first two and recommended the third. He asked me for another session – which I believed to be another testing session but which I found out later was a session to fit the

appropriate mask. (CPAPs were sold in a store that was part of the clinic.)

«««««« Insert Figure 1 about here »»»»»»

I had done considerable research on obstructive sleep apnea by the time I came for the second session. I was not convinced that a CPAP would improve our quality of life. I did find two alternatives: (a) mouth exercises to strengthen the muscles in the back of the mouth, which prevents it from collapsing and (b) didgeridoo playing, which has the same effect. There were controlled medical studies on each of these methods with patients who had moderate levels of obstructive sleep apnea (about 20 episodes per hour). Both treatments had lowered, on average, the incidence of episodes from just over 20 to about 11 episodes per hour within 3 months. I left copies of the studies with the sleep clinic. The night was even worse, as all masks the technician tried gave me an experience of drowning (apparently, I could not breath against and overcome the minimum pressure). At midnight, I forced the abandonment of the trial. When I returned for a final interview, the sleep specialist suggested that the CPAP device was not working for me and that I could easily live without one. He laughed off the possibility of the alternative treatments.

Getting a Grip on Chronic Fatigue

Medical didgeridoos were available only in Europe (Switzerland), where it is also possible to receive training in playing the instrument. With information again culled from the Internet I constructed a cheap alternative: a didgeridoo from black ABS plastic pipe. I also perused videotaped lessons from YouTube. I did the mouth exercises. In the course of the next three months, my sleep improved and I began to feel better. I later learned that when, for a variety of reasons, I did not get to do the mouth exercises for several weeks, the apnea episodes became noticeable and I repeatedly woke up at night with a racing heart, something I did not experience during periods with regular practice. I learned that whereas the sleep specialist had (only) symbolic mastery over apnea, its causes, and its control, for me the symbolic was and became flesh – I *lived* the changes that the medical studies about didgeridoos and mouth exercises wrote about. This lived body "cannot ever be an object . . . described by the anatomist or examined by the doctor" (Henry, 2000, p. 218).

I had not stopped to look for (scientific) information. Periodically I conducted researches on the Internet. In 2012, following a move to Australia and living without a house and garden to care for, I spent more time exercising. I had symptoms of fatigued muscles that did not recuperate. At that time, I made two discoveries on the Internet: most of my symptoms were also associated (a) with gluten intolerance and (b) lack of protein. I had repeatedly pointed out to the various doctors the strong odor of ammonia after exercise, especially noticeable when I wore a rainproof jacket, which concentrated moisture from sweat in the clothing. A further Internet research showed that a lack of protein in the food leads to muscle protein being broken down and consumed: my body, to get energy, was feeding on itself. In the process, ammonia is produced. Whereas it is normally passed out with urine, during heavy exercise it leaves the body with sweat and, because its levels increase in the body, it also leads to immediate fatigue because of effects on the brain and long-term fatigue because of the loss of protein in muscle. Whereas chemistry or biology students may be able to memorize some facts and equations about this process, nothing seems to replace the joint experience of workout, fatigue, and the stench of ammonia.

I made two nutritional changes that had tremendous effects on life. I changed to a

gluten-free diet, which led to almost immediate decrease of some symptoms (e.g., tremendous levels of bloating). I ate more regularly and supplemented my vegetarian diet with levels plant-derived (complementary) proteins at levels recommended for those on heavy exercise regimes. Within a few weeks, I was able to expand from the 100–150 km per week exercise regime to 600 km and more per week. The average speed on the tours increased to rates that were similar to those 20 years earlier, at an age of 40. Interestingly enough, a high quality of plant-based protein comes from hemp, the same plant that also produces the THC and that can be grown, because of its resilience, without pesticides and herbicides.

Together with these exercise-related changes, my capacities at work also increased. I was able again to work at the desk for 8 to 10 hours, as I had been able to do prior to the onset of the debilitating fatigue. At last, a sense has emerged of having conquered decade-old problem. I know that I have to continue the mouth exercises, because after having stopped or been slack about them, I experienced an increase in apnea – which I know to have occurred when I wake up with increased heart rates and less than the required sense of rest when I get up in the morning.

Science | Environment | Health: Linking Pathos and Cultural Practices

The purpose of this study is to exhibit and theorize a link between personal health, environment, and affect as a possible setting for teaching science. In the preceding accounts, two kinds of data are presented. The first point to the incarnate, first-body experience of a chronic illness, which, as such, because of its singularity, cannot be shared; and what can be shared (second body) inherently is in terms of language and therefore cultural (third body). The second pertain to cultural practices related to different medical systems (standard, alternative, and self-help medicine). As a natural scientist with graduate and post-graduate experience in physics, physical chemistry, and biology, I have come in contact with and learned a lot of scientific knowledge. However, in the case of my illness, much of the knowledge I had learned was not applicable – though it helped me to be suspicious in such cases as the electrochemical potential between gold crowns and cheek. The study shows that even with tremendous background in science and science education, our symbolic knowledge is insufficient to cover those cases in real life that where science is really most relevant: there where it literally is made flesh (first body). My health practitioners, on the other hand, literally did not know – i.e., have had experience of – what they were talking to me about. In the absence of the pathic experience, even em*pathy* becomes symbolic (Roth, 2011, 2012). It was in the course of pursuing a problem that touched me at the core of my being that I – in *sustained* inquiry that required no (outside) motivation – found out about and came to practically and bodily understand issues related to health, diet and exercise, and physiology. I found out enough to be able to make scientifically informed decisions about changes in my life style. Although the role of my *prior* scientific knowledge was minor, it may have been my scientific background that made me rely more on empirical (treatment-control) studies rather than on simple assertions that something "may assist" in treating my problems.

The difference between pathic experience and talk about it can be understood in terms of the distinction between Being [*Sein*], which refers to pure presence experienced in the

first body, and beings [*Seiendes*], which include things, words, and any other *re*presentation (Heidegger, 1927/1977). Being, the first body, can be "grasped" only through beings (words, signs) that make Being present again when it is absent and refer to the way in which the first body is transcended and comes to stand out (second and third body). Science and technology, which deal only in and with *re*presentations, completely substitute beings for Being (life) so that even biology, the science of life, fails to deal in the *bios* (life) of the ancient Greek (Henry, 2000). Whereas doctors master the discourse and other representations pertaining to an illness or disease (i.e., beings), they do not generally have the experience of living (with) an illness or disease. The gap between Being (living) and beings is bridged when we are afflicted. It is in this moment that the words of science (beings) become flesh (Being).

After a lot of trying, abandoning, and retrying and only about 6 months before writing these lines, radical changes in diet – the very place where there is an interaction between environment and the personal body – led to equally radical changes in my physical and emotion well-being. The science had gone under my skin. Using approaches typical for single case (i.e., $N = 1$) designs, I had eliminated and reintroduced certain foods, monitored the relationship between climate, exercise levels, and intake of liquids and minerals to arrive at a personal health that exceeded the state prior to the illness. In the course, I learned a lot of science, learned to eliminate medical studies the results of which may have been spurious or reported false cause–effect relations. All this science was not just grasped symbolically but was literally personalized, motivated by the search of finding a solution to a problem that had touched me at the core: The growing of marihuana and preparation of TCH, the purchase and practice of sauna, the dietary changes all *directly* and without mediation *affected* me. Pain and fatigue were not just things to be known and talked about but these affected me, and these disappeared with certain actions. Illness taught me that we are exposed to illness, pain, or fatigue and that these are *present to us* prior to any conceptualization thereof in the form of *re*presentations.

In the process, formal biomedical and alternative medical systems were both helpful and unhelpful simultaneously. Both provided tremendous amounts of knowledge, accessed through Internet searches and enacted in the medical offices, and shut down more ecological and collaborative approaches to the identification and solution of the problem. Three pertinent issues to be discussed stand out: (a) medical practitioners often only have symbolic access to the illness they are asked to treat, (b) the use of a one-variable-at-a-time approach, and (c) the absence of a collaborative endeavor in both biomedical and alternative medicine.

First, in the course of my illness I came to understand that my *pathic* experience was inaccessible to the doctors. That is, whereas we could *talk about* my pain – e.g., in the knee or shoulder joints – our talk was not the living phenomenon itself: *my* pain. I did not want this pain. I could not interpret and construct it differently to make it disappear. But those I sought out for help only knew illness symbolically: the sleep specialist has not had to live with apnea and the rheumatologist has not had to live with chronic joint pain. Thus, the doctors have been in a situation similar to that in which science students tend to find themselves with respect to scientific topics and discourse: They have *symbolic* access, they know (at best) *about* the symptoms. But, day-in and day-out, I had to live with this debilitating illness. They suggested treatments, such as vitamin B12 supplementation or shots, but they did not have to live (with) the (non-, ill-) effects of the treatment. The sleep

specialist prescribed a CPAP device that should have kept the airways open, but, during a test, I was subject to the sensation of drowning and gasping for air that he had never felt. Yet, in a dialectical inversion of the problem, I was in no better position than the doctor to articulate the pain and fatigue. The ex*per*ience – from the Proto-Indo-Germanic root *per-*, passage, danger, transition, ford, and limit – eschewed all symbolic means of *grasping* it. Whereas this assessment of (medical) knowledge appears negative, it does have a positive aspect: It is precisely when science education enables students to begin their learning trajectories with personal illness and health issues that these come to *affect* students. Their interest and intention to learn will arise from being affected rather than having to be invoked by symbolic means. For example, students may bring and talk about their own X-ray images rather than about those taken of anonymous people (Zeyer, 2012).

Second, the formal and alternative medical practices exercised a one-variable-at-a-time approach. Whereas they thereby came to exclude which factor *by itself* was not the cause, other, ecologically mediated forms of causation were missed and, therefore, the living-body-in-the-environment. The medical practices attempted to locate illness in the material body of the person rather than taking a broader, environmental perspective. Thus, the conditions and well-being related to environmental factors and interactions with the environment, for example, in nature and quality of foods, thereby never could become facts to enter diagnosis and treatment. Especially those factors that could have pinpointed problems arising from the relations with the environment and those related life-style related environmental conditions were not pursued. A relation between food, physical exercise, odor, and fatigue might have been detected earlier and within the official medical channels. This is consistent with the much publicized searches for treatments of cancer or obesity that affect the individual body, which could then be treated by medication-based (quick) fixes. This approach eschews and makes us blind to any attempt and political need to find and address (possible) causes that arise from pesticide load in the environment, heavy metal load in certain foods, chemical contaminants, and so on. In a broader perspective, it would be possible to theorize an integral relation between environmental health and human health. "Treatments," therefore, could then begin with rigorous implementation of policies that decrease environmental factors that mediate human health. On the positive side, this becomes an opportunity for science education, which may be interested in fostering a new approach to science that is oriented to articulate and solve problems in an ecological manner. This approach to science was characteristic of the Nobel Prize-winning Barbara McClintock, who did her science in contrast to her male colleagues (Fox Keller, 1984). But as the title of her biography expresses, a *feeling* for the organism provided new and different insights to science. It may well be a more suitable approach to science education than classical science and its endeavor of disembodied and disinterested knowledge.

Third, during the investigation, neither the doctors from the regular medical system nor those practicing alternative medicine drew on what we might call my natural expertise and interests. Although environmental medicine emphasizes the need of collaboration between patient and health practitioners, the patient in this situation was present only as an objectified body. The patient, the living person most affected by the issue, was not involved as a in the process of finding out about the illness or in the collection of the data. Although one might have thought that there could have been a particular appeal to involve me, because of my science and research backgrounds – e.g., by producing a dispassionate,

precise protocol of nutrition and lifestyle – there was no attempt to bring about or encourage such a collaboration. A log of all activities, all food intake, and any other possibly factor in a log would have enabled an extensive examination of a range of factors. It would have been not only in my own interest of participating but I would have been subject to whatever changes in lifestyle we might have come up with as a result. That is, even though in this case both doctors and patient were highly trained, a *con*versation discussing the scientific basis and merits of the case and diagnosis never took place. There may therefore be a need for two areas of increased scientific literacy. On the one hand, the "core practitioners" in the sciences, environment, and health fields have to be scientifically literate in the sense that they have to be capable and willing to communicate with others in a way that allows knowledge from their specialty field to inform relevant discussions. On the other hand, patients have to be more assertive requesting participation than I have been in the process. New possibilities may then arise when health and environment individually seen but especially from their interrelation in ecological medicine, should be a cooperative project involving patients and health practitioners (Science and Environmental Health Network, 2002). This is double-pronged scientific literacy may be the new goal that a health and environment focused science education may provide itself.

Implications for Science Education

This study exhibits (medical, environmental) science, its content and nature, in the process of a chronic illness and the resultant pursuit of personal health and well-being. Science came to be related to what really affected me; and it offered me ways of going about making changes that would in turn affect me. I open my first-person account of an illness and the pursuit to improve living (with) it with a biblical quotation: "And the word was made flesh." The quotation was used deliberately, because it figures centrally in a text offering an radically alternative to constructivist epistemology: incarnation, or a phenomenology of the flesh (Henry, 2000). As studies in mathematics education show, this epistemology is also overcomes limitations of embodiment and enactivist accounts, which only treat in the second and third bodies but not in first body (e.g., Bautista and Roth, 2012; Roth, 2010). By making the first body thematic, we can formulate a form of science education that really matters, goes under the skin, and literally affects us in flesh and blood.

In this study, personal health and well-being were understood and treated to be irreducibly tied to environmental health, leading to changes in the home, immediate environment (garden), and types of food (organic, non-GMO). These are not merely symbolically grasped relations, but real effects that literally affect the person: physically and emotionally (affectively). There are also moral implications for science pedagogy (e.g. van der Zande et al., 2012) that all-too-often remain unaddressed in science courses and science teaching methods courses (Roth, 2013b). This concern for personal health and well being also became an advocacy for environmental health and well being in and through the practice of sustainable permaculture and the contribution to making wildlife corridors. Personal care and environmental care came to be integrally related.

A core goal of science education is for students to develop competencies required for making decisions about alternative actions in a "politicized ethics of care," which "entails becoming actively involved in a local manifestation of a particular problem, exploring the

complex socio-political contexts in which the problem is located, and attempting to resolve conflicts of interest" (Hodson, 1999, p. 789). Considering the anchoring that living an illness provided to my intention to learn and the relevance of (symbolic) scientific knowledge, my recommendations include to organize science curriculum around issues that are of personal relevance to, because they *directly* affect, students. There is nothing more local (situated) than personal health, which affects us in an unmediated manner and despite any form of personal and collective knowledge. But personal health is tied irremediably to environmental health (Keselman, Hundal and Smith, 2012; Science and Environmental Health Network, 2002). That is, the politicized ethics of care first and foremost can be grounded in personal and environmental health, (with) which we have to live rather than merely understand. In the context of a public, politicized, and mediatized ethics of care students are enabled to work towards decisions about the way in which they lead their lives, the foods they want to eat and not eat because these contribute to a/n un/healthy lifestyle, the role of exercise in health and well being. Lifestyle, health, and well being are no longer symbolically accessed, as are almost all topics in present science curriculum, which is why they may touch, affect, interest, and engage students. Environmental and personal health, because these are close to and go under the skin (affect the first body), are ideal contexts for learning not only symbolically but also in flesh and blood and by modes inaccessible to language.

Personal health questions are expandable to epidemiological studies, which could link children in any school to those in another other school within a country and with one or more schools in other countries wherever these are located in the world (Zeyer, 2012). There is an interaction between the environment we create and inhabit and the kinds of choices we make. It is well known that children will request candy if these are displayed in prominent places in the supermarket, such as the checkout counter, and where parents are less likely to engage in behaviors that would limit their children's access to the foods that lead to obesity. There are also close links between diet and acne (Melnik, 2012), an important issue during teenage years, so that choices students at that age make literally go under the skin rather than merely being symbolically known about. It is not the dietary counseling that will motivate changing dietary habits and an understanding of the relation between environmental chemistry and our bodies; but the experience of disappearing acne is much more profound and affecting than any change in the theoretical grasp of the matter. There therefore is a yet-to-be-explored potential for transforming the world through education, where science plays one part in the bigger picture of education, though it no longer plays the exclusive domain from which to consider curriculum content and process.

Making the science curriculum relevant to students may mean that there are as many different topics of inquiry as there are students in a class; moreover, making the science curriculum relevant changes assessment of effectiveness. In both dimensions, the roles of science teachers change in radical ways, though in ways that some teachers already have shown to be possible (Roth and Lee, 2006). These authors describe how learning, when the boundary between school and community has come down and where students write their own curricula, emerges from what is truly relevant to students. Although it took the teacher some time to move from a traditional to the new organization of his classroom, learning emerged "from the collective activity of the class, what the events globally bring about" (p. 34). Although formal assessment was absence in the practices of this classroom, when the children were formally assessed after they had left the school, they scored above

the national mean.

Tearing down the boundaries between school science and the world outside by focusing entirely on what matters most to students – e.g., their personal and environmental health – may have multiplier effects. Thus, for example, the study concerning an intervention in Tonga, where the obesity rates are the highest in the world, shows that there are multiplier effects deriving from such efforts as operating gardens and commercial operations (Fotu et al., 2011). The study authors observed that "growing of vegetables was a key plank of the nutrition objectives. The main strategies were to make vegetables available for a community's own consumption and to simultaneously improve eating habits." There was then a multiplier effect when the gardens encouraged the establishment of new gardens in new sites. This case therefore shows that there is more to solving a health problem than teaching something in school science. In fact, if anything, we can learn that this health crisis needs to be thought from the plenitude of life, as science educators have recently suggested (e.g., Roth and van Eijck, 2010) and in terms of society as a whole, with its attendant division of labor and distributed forms of expertise (Roth and Lee, 2002). Science then would take its place among many other forms of knowledge and relations that sustain and transform society – an approach that would clearly address the issue of diversity that is so central to an ecological approach to medicine (Science and Environmental Health Network, 2002). Economics and cultural traditions are just as important as knowing about how to optimize crops without chemical fertilizers and in sustainable manner without pesticides or herbicides. Running a school garden not only produces vegetables but also comes with many opportunities to learn about the relationship between environmental and personal health and well being (Roth and Lee, 2004). An organically run garden not only provides for nutritious and tasty foods but also can become part of a stewardship project – as I know from personal experience – and can lead to the establishment of corridors suitable for migrating wildlife. There is an increase in many species of wildlife, including pollinating species such as butterflies and different bee species. Students not only garden but also prepare and taste raw and cooked versions of what they have grown. It is even possible to sell the produce, which would allow an expansion in the learning opportunities, for now economic factors would enter the educational considerations.

The present case study shows how, in everyday life, our knowledge pursuits are organized around projects and issues that directly affect the individual and its environment rather than by academic discipline. Whatever form of knowledge offers the potential to contribute to a solution enters the decision making, and sometimes it is not based and even contradictory to science (e.g., the complicated relation between marihuana, health, addiction, and law). Implementation likely will be less successful if traditional structures of schooling are maintained, which (a) interfere with the sustained level of uninterrupted engagement that any project in everyday life requires and which (b) in contrast, to voluntary after- and out-of-school opportunities (e.g., Hundal, Levin and Keselman, this issue), force students to participate in tasks over which they do not have control in terms of structure, content, or evaluation. The structure of schools, as some science educators have suggested, is itself the problem why science education is perceived as having so little relevance to students' lives (e.g., Larochelle, 2002; Roth and McGinn, 1998; Roth and Barton, 2004). Moreover, as observations of teaching the potential social, health, and environmental impacts of genetically modified crops show, there may be a "disconnect between the relatively mature conceptualizations of effective SSI instruction that emerge

during interviews and classroom practice" (Gardner and Jones, 2011, p. 1031). A much more radical interrogation of science education and its nature may have to occur, just as for any other school subject. Thus, just doing the same old things with a new topic – science | environment | health – would not do the trick. In response to the question posed in the title of this article, one may say this: If science | environment | health were but a new driver in the same structure of schooling (new wine in an old bottle), then there would not be real change. If this new topic and approach were to be one of the options, or one of the features that students would be able to pursue in an engaged and sustained manner, away from the traditional cycles, temporalities, and rhythms that currently characterize school life, then this is more of what I have in mind for a new form of science education that understands and theorizes itself from the whole of which it is a constitutive part – a resource in and to lifelong learning.

The proposed approach that anchors science education in the first body, which is the one where we are affected and in and through which we suffer our afflictions, is not a cure-all. We do know that doctors and scientists themselves often act against the spirit of the advice they give their patients. Thus, some physicians advise their patients about maintaining appropriate levels of their diet and are overweight themselves; some advise against smoking but continue smoking themselves (a case in my extended family); or a Monsanto scientist who contributes to developing GMO crops only buys certified organic food for his own consumption (a fellow passenger of mine on a plane). In all of these cases, there is a gap between what highly informed and trained individuals say ought to be done based on their knowledge (discursive action) and what they themselves do (practical action) to themselves and the environment. It is the same kind of relation my health practitioners have had with the illness that I had to live and live with. To paraphrase Marx/Engels (1958), the health practitioners only interpreted pain and affliction differently and grasped it symbolically; for me the point was to live differently. There is therefore never a guarantee that students who are involved in environmental activism will actually continue to engage in pro-environmental behavior or those involved in health-related initiatives will lead a healthy life. As acne literally goes "under the skin," affecting teenagers physically and emotionally, an investigation of acne and environmental or comedogenic (acne-causing) cosmetic substances will have greater impact on and directly changing student lives than the study of traditional school science topics in mechanics, the particulate nature of matter, or the Krebs cycle. In addition, the relation between carcinogenic substances and comedogenic activity (Kligman and Kligman, 1994) could lead to extended investigations about scientific, environmental, health, political, or economic connections associated with the production of cosmetics. At the same time, students would have an opportunity to learn *about* the difference between their living body, and how it expresses itself in illness and medical issues, and the way this body comes to be presented objectively in medical and environmental discourse.

Finally, this study also intimates that a new epistemology is required, as all forms of constructivism, by their very nature focusing on representations of our bodies and the world, have no means of theorizing the pathic knowing through the first body (Roth, 2011). In and through the experience of a chronic illness and the related analyses that followed, I was confronted and engaged with for me novel formal biomedical and alternative medical knowledge. In the process, I came to understand (a) not only the role of pathos in illness but also (b) the foundational role of the pathic in all forms of knowing and (c) the point of

breakdown of currently dominant (constructivist, structure/agency) epistemologies, which fail to account for the pathic. Prior to all knowledge and intention of an agential subject, an illness, as all pathic phenomena, is an event that we are subject to and subjected to. Prior to naming something, such as fatigue, it has to emerge from a voiceless, invisible life, which only expresses itself in living (Henry, 2000). Life, its modalities of pain and fatigue, arrives prior to knowledge of causes, which, in the present instance, never were articulated with any certainty. Addressing pathos, because it literally *affects* students physically and emotionally, means allowing them to engage according to their (passively) experienced and perceived needs. Students would be enabled to understand the relationship between ourselves and the representations thereof. In the context of the environment, they are enabled to understand a person as an abstraction from larger systems (ecologies) that are open rather than closed, where there is a continuous *flow* between what momentarily can be considered to be parts, each of which cannot be understood without the relation to the whole and, therefore, to all other parts. Students ought to be allowed to come to understand their own nature as an integral moment of environment writ large, where there are continuous processes of exchange across open boundaries that are themselves subject to continuous change. The food they eat, the air they breathe, the (legal and illicit) drugs they consume, the exercises they do or do not engage in, or the chemical environments that they are in continuous exchange with – all of these processes will have their corresponding effects on how we feel and experience ourselves.

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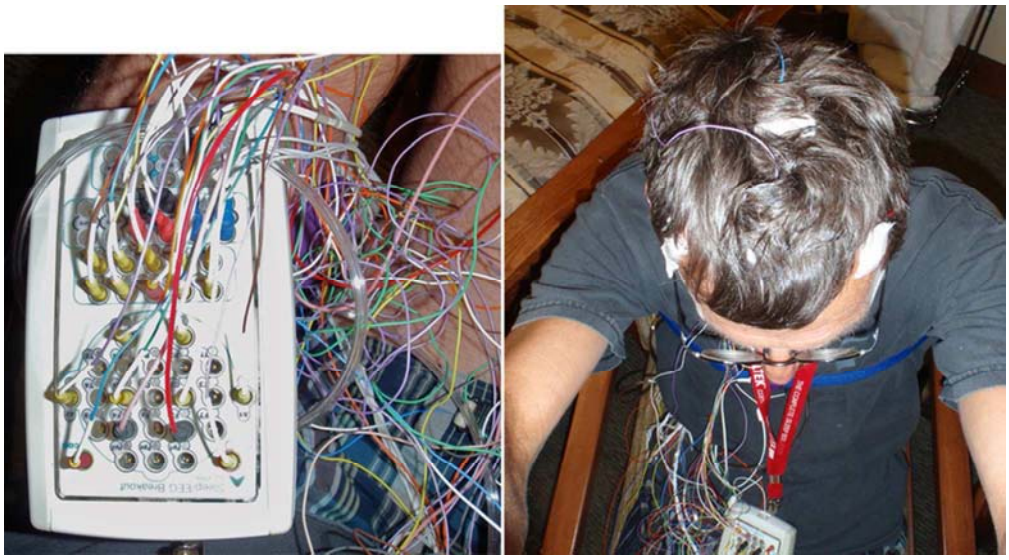

Figure 1. The real, sensuous me, attached to a multitude of electrodes all of which fed into one single computer system, has become an object of a medical examination leading to my objectified body.
69x38mm (300 x 300 DPI)