University of Alberta

Ecological literacy materials for use in elementary schools: A critical analysis

by

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We stand now where two roads diverge. But unlike the roads in Robert Frost's familiar poem, they are not equally fair. The road we have long been traveling is deceptively easy, a smooth superhighway on which we progress with great speed, but at its end lies disaster. The other fork of the road / the one less traveled by / offers our last, our only chance to reach a destination that assures the preservation of the earth.

— Rachel Carson

For my daughter Christina and my sons Aaron and Rhys
— you fill my heart, you are my strength.

ABSTRACT

My research is a critical examination of environmental science education resources for use in Alberta schools. I examine both the resources and the processes by which these resources are developed by diverse groups. My inquiry is guided by the following question: *What is the nature of the discourse of ecological literacy in the promotion and content of teaching materials in elementary schools in Alberta?* This critical analysis centres on the discourses, language, and perspectives (both hidden and overt) of these resources and processes; the manifestation of political agendas; existing relations; and the inclusion or exclusion of alternate views.

Framed within critical theory and an ecosocial construct, my methodology employs critical discourse analysis and hermeneutic interpretation. I analyse selected environmental science resources produced for the elementary classroom by government and nongovernment organizations. I also interview the producers and/or writers of these instructional resources to provide the perspectives of some of the developers of these materials. The findings illustrate how the discursive management of the view of nature, human-nature relationships, uncertainty, multiple perspectives, and dimensions of ecological literacy in materials for schools offer students a particular perspective. These ecological and science discourses act to shape their personal relationships with nature and notions of environmental responsibility and consciousness. This research is necessary because, particularly in Alberta, corporate interests have the potential to impact school curricula. The study points to a need for a critical appraisal of resources for schools produced by the environmental science community.

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CHAPTER 1: INTRODUCTION

Special Places and Childhood Memories—An Introduction

Sitting in the cool shade under the old wooden trestle bridge, I listen to the quiet tumbling of water over the rocks, interrupted by the occasional splash of a creature, perhaps a frog or fish. I watch the small creek ripple and eddy as it leisurely meanders by. I smell the tarry aroma of the old wooden beams. I spy silvery minnows darting about in the shallows. Sometimes, if I am fast and daring enough, I catch a frog, only to let it go moments later. I wait in anticipation for a car to rumble overhead, shaking dust down through the boards of the bridge as it passes. But they don't pass by often. It is, after all, only a small bridge over a similarly small creek on a quiet country road.

I share this childhood memory of one of my most favourite places as a starting point. Though I grew up in the city, I spent nearly every childhood summer at my grandparents' farm. The little bridge just down the lane was a quiet, special place I visited often through the passing years of childhood. But one summer, in my early twenties, I returned to the farm to find the bridge torn down, replaced by a giant metal culvert. I felt shaken by what I saw as the destruction of a very special place. I was told the old bridge needed replacing—it had become unsafe. But to replace it with a culvert seemed so wrong to me. I realise it was simply a matter of economics and ease, but as a consequence, my connection to this special place, this little creek, was forever changed, imprinted indelibly on my consciousness. My childhood memory of this special place and my reaction to its ruin has acted, in part, to shape my present-day relationship with nature—what I like to think of as my ecological identity (Borden, 1986; Thomashow, 1995).

Thomashow (1995) defines ecological identity as, "all the different ways people construe themselves in relationship to the earth as manifested in personality, values, actions, and sense of self. Nature becomes an object of identification" (p. 3). He draws upon the work of Gary Snyder (1990) and David Sobel (1993) as he explores how childhood memories of place and the experience of disturbed places shape our ecological identity.

As a child, I was fortunate to encounter the natural world in many ways and in many special places. Not only did I spend those long days of summer in the countryside at my grandparents' farm, my family holidays, more often than not, took place in the mountains, the woods, or by a lakeshore. My father and grandfather encouraged my curiosity, allowing me to explore my surroundings and to interact with its many inhabitants (at least none that might prove dangerous). I kept frogs, lizards (though I now know they were salamanders), spiders, ladybugs, and any other manner of small creature at one time or another. I remember the sounds and smells of the woods, the reedy lakeshore, and the old wooden bridge. The relationship with nature I had as a child had a profound effect on shaping my identity. My childhood memories of special places and awareness of the disturbance of many of those places provides a backdrop for my sense of connection and place in the more-than-human world.[1] I draw your attention to Thomashow's (1995) notions of ecological identity and to my story of the long-gone wooden bridge as a means for understanding, in some measure, who I am, how I came to this inquiry, and why I believe my research matters.

[1] This phrase originates from environmental philosopher David Abram (1996) in his book *The spell of the sensuous: Perception and language in a more-than-human world.* Abram argues, "we are human only in contact, and conviviality, with what is not human" (p. ix) – the term more-than-human refers to the experiential and sensuous world of nature (or environment) of which we are but an interconnected part.

Purpose of My Research

Environmental education in many education jurisdictions is not offered as a discrete subject, but rather is subsumed primarily within the subject of science and, to a lesser extent, social studies (Simmons, 1989). In Canada, education falls under provincial jurisdiction; consequently, how provinces approach environmental education differs greatly, from cross-curricular integration (e.g. British Columbia Ministry of Education, 2005) to a somewhat piecemeal or marginalized approach[2] (Alberta Education, 2005a; Alberta Learning, 1996). Hart (2003) suggests that children's school experiences act to shape their personal relationships with the social and natural world and that these relationships frame their sense of social and environmental responsibility. Similarly, Östman (1994) argues,

> The subject matter of science inevitably offers students a view of nature and of the relationship between human beings and nature. It is therefore not possible to isolate or to separate the teaching of science concepts from socialization in to some kind of environmental consciousness. (p. 142)

If Östman is correct, that places a particularly heavy burden on science teachers—how are we, effectively, socializing our students? As a consequence of our teaching, what kind of environmental consciousness will our students develop? How will the textual resources we bring into our classrooms and depend on for instruction impact our students? What ecological identities will we, as classroom teachers, have a hand in shaping?

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[2] Though not explicitly stated as environmental education goals in the Alberta Elementary Science (Alberta Learning, 1996) or the Alberta Social Studies Kindergarten to Grade 12 (Alberta Education, 2005b) programs of studies, ecological understandings and environmental issues are included in several of the topic areas.

As an elementary science and environmental educator, my experiences with environmental science resources left me with a sense of disquiet. Coupling Östman's notion of the moral nature of science teaching with the embedded nature of environmental education in Alberta elementary science instruction has fostered my deep concern about the classroom resources available to elementary teachers. I have at times been dissatisfied with the implicit and sometimes overt messages [or using Östman (1994; 1998) and Roberts' (1995; 1998) terminology, companion meanings] about nature and our human-nature relationship—messages embedded in the language of the resource. My sense was not one of interconnectedness but rather of separateness and hegemony. I question the perspectives presented. I am concerned about possible political agendas as many of these resources are corporate sponsored or produced. These questions and feelings of concern compel further inquiry.

My doctoral research is a critical examination of environmental science education resources for use in Alberta schools. I examine both the resources and the processes by which these resources are developed by diverse groups. My inquiry is guided by the following question: ***What is the nature of the discourse of ecological literacy in the promotion and content of teaching materials in elementary schools in Alberta?*** This critical analysis focuses on the discourses, language, and perspectives (both implicit and explicit) of these resources and processes; the manifestation of political agendas; existing relations; and the inclusion or exclusion of alternate views. My research explores the following sub questions: Do the materials present multiple perspectives, if so, of what nature? How is language used to mediate the various dimensions of ecological literacy? What views of science are portrayed? What views of the natural world and human-nature relationship are presented? How is the notion of uncertainty discursively managed? What

decision-making processes and avenues for scientific and ecological discourse are advocated? As this study also investigates the perspectives of the producers and/or writers of environmental science resources—perspectives reflective of the organizations—the additional following sub questions form part of my inquiry: What perspectives on environment and environmental education do they hold? What do they perceive their role in resource production to be? Does corporate sponsorship and partnership influence resource production? I explore these questions and ideas through a critical discourse analysis of the classroom resources and through interviews of the producers of these resources.

Significance of the Inquiry

Few researchers have taken an ecological literacy and critical perspective to investigate the discourses of instructional materials produced by outside agencies (cf., Kelsey, 2003; Stamou & Paraskevopoulos, 2004). The importance of my study centres on the ways in which the discourses of these agencies seek to influence and shape the enacted curriculum in the classroom and to raise awareness of the possible influence of corporate entities. Prior research has shown that corporate interests can have a great impact on school curricula (cf. Eyre, 2002; Taylor, 1998). This study will carry implications for ecological literacy endeavours. My research will inform policy and curriculum developers and classroom teachers faced with a growing array of environmental science resources produced by government, industry and not-for-profit agencies by highlighting the positions presented. It will be useful for teacher educators who must help pre-service teachers to become perceptive users of commercial resources. Further, my research has the potential to assist organizations and resource developers in

enhancing the production of environmental science resources and instructional materials. Finally, my conceptualization of ecological literacy may have significance for the notion of education for sustainable development, currently being promoted by UNESCO (2005).

Alberta Context

The province of Alberta is renowned for its natural beauty and diverse landscapes, from the Rocky Mountains to the Badlands, from the Boreal Forest to the Prairie Grasslands. Alberta is also known for its significant economic dependence on the fossil-fuel and forestry industries and conservative politics. Within this context, instructional resources produced in Alberta present a particular view of the environment and our relationship to the natural world. Alberta Education, the provincial K to 12 education and curriculum governing body, does not prescribe a text for elementary science; rather resources are authorized for use in the classroom, though not all of the resources in use in the province's classrooms are authorized.[3] The available resources effectively shape the enacted curriculum (Apple, 2000; Connelly & Clandinin, 1988; Gee, 1996; Jackson, 1992). This is particularly true in elementary science education because elementary teachers are typically generalists without advanced science learning. As such, they are very reliant on available resources (Rowell & Ebbers, 2004).

In Alberta, several subcommunities, including government, industry, nongovernmental organizations (NGOs), and school districts, develop and promote a wide assortment of science/environmental education resources. In many cases, the

[3] The resources included for analysis in this study are not authorized texts. Though the specific use by teachers for planning and instruction of most of these texts is not documented, the resource producers indicated they had a fairly wide distribution of their resources. The prevalence of the school district produced text included in the study has been documented; these publications are widely used by elementary teachers [69% of the province's teachers (Rowell & Ebbers, 2004)] and yet are not Alberta Education authorized resources.

resources are produced through a 'partnership' among industry, government, NGOs and/or environmental nongovernmental organizations (ENGOs). Many organizations claim their educational materials are "bias-balanced" (e.g. Inside Education, SEEDS), that is, present multiple perspectives in an impartial manner. Whether they do or not, or even can (cf. Apple, 2000), or should (cf. Fien, 1993a, 2000), remains open to question and further study.

In the pages that follow, I construct an argument which will highlight the need for research to critically examine the discourses of classroom environmental science resources and their production. I begin with a review of the literature, conceptualizing a theoretical perspective and framework for my research. Following an explanation of methodology, I describe the analyses and findings of my research concerning the discourses of the instructional resources and interviews with the resource producers/writers. I next turn to a discussion of these findings, their implications for theory and practice, and explore avenues for further research. I bring my thesis to a close with an Afterword—a short discussion of the current socio-political climate and context for environmental science education and ecological literacy in Alberta.

CHAPTER 2: REVIEW OF THE LITERATURE

My review of the literature begins with a brief elucidation of the terms environmental and ecological as a prelude to an exploration and conceptualization of ecological literacy and curriculum. As my research is concerned with the language and discourses of ecological literacy materials for use in the elementary classroom, a discussion surrounding language and discourse is essential. I follow this discussion with an exploration of social and ecological theory and perspectives, conceptualising the framework for my research within ecosocial theory. I conclude this review of the literature with a critical look at the place and role of text.

It is necessary that I clarify the distinction between the terms *ecological* and *environmental.* These words are often used interchangeably but their actual meanings are quite different. The word *ecology* originates from the Greek *oikos* "house, dwelling place, habitation" plus *-logia* "study of" ("Online Etymology Dictionary," 2001). The word ecology is now used by some to encompass the interrelated connections between all things, relationships which operate to shape our identities (Davis, 2004). Borden (1986) further supports this thesis and states, "the study of ecology leads to changes of identity and psychological perspective, and can provide the foundations for an 'ecological identity'—a reframing of a person's point of view which restructures values, reorganizes perceptions and alters the individual's self-directed, social, and environmentally directed actions" (p. 1). As a scientific discipline, ecology is the study of the processes that influence biodiversity, the interactions among organisms, and the relationships between organisms and the physical world. It is necessarily complex, interconnected and dynamic.

Conversely, the word *environment* implies a sense of separateness between human beings and the natural world (Davis, Sumara, & Luce-Kapler, 2000). The term is derived from Old French from *en-* "in" + *viron* "circle, circuit" ("Online Etymology Dictionary," 2001). Thus, the word 'environment' suggests a modernist sensibility (Davis et al.); it does not imply the same sense of relationship and interconnection with nature and Earth processes as does the word 'ecology' (Davis, 2004). Berry (1977), in explaining this distinction, says, "once we see our place, our part of the world, as *surrounding* us, we have already made a profound distinction between it and ourselves" (p. 22).

However, it should be noted that, within education, the terms ecology and environment are generally used to distinguish the scientific discipline from education in, for and about the environment. Environmental education encompasses the science of ecology plus social, philosophical, aesthetic and cultural considerations. For my research, I prefer the term ecological over environmental. The interconnected and complex perspective the word ecology connotes sits better with my own perspectives and worldview. Additionally, my primary concern is with science education and the natural world. Use of the term ecology helps to focus my research on environment as it pertains to the natural world and our relationship as human beings with this world. However, as I draw on the work of diverse environmental educators, the terms ecological and environmental may be used interchangeably, especially as coupled with literacy. Wherever necessary, I will clarify contrasting perspectives.

Ecological Literacy Conceptualised

In describing what is meant by ecological literacy, Orr (1992) eloquently suggests, "ecological literacy is driven by the essence of wonder, the sheer delight in

being alive in a beautiful, mysterious, bountiful world" (p. 86). Broadly defined, ecological literacy implies a basic understanding of the natural world and the interconnectedness of life. Such an understanding would necessarily be grounded in the study of ecology, natural history, biogeochemical cycles, and the importance of place (Orr, 1992; Thomashow, 1995, 2002). Ecological literacy education fosters an ethic of care and stewardship (Orr). An ecologically literate person would have the "practical competence required to act on the basis of knowledge and feeling" (Orr, p. 92).

Capra (1996) defines being ecologically literate as, "understanding the principles of organization of ecological communities (ecosystems) and using those principles for creating sustainable human communities" (p. 297). His concern centres on human systems enveloped within ecosystems and the interconnection and complex relationships inherent within. Capra delineates the principles of ecology as interdependence, partnership, recycling, flexibility, diversity, and, as a consequence of living according to these principles, sustainability. The principle of interdependence necessitates an understanding of relationships—holistic, interconnected, non-linear, and patterned relationships. With partnership, Capra emphasizes cooperation, conservation and democracy within human communities. The cyclical nature of Earth's processes is inherent within the principle of recycling—understanding the ways in which nature 'recycles' and applying those ideas to human communities. The ecological principles of flexibility and diversity "enable ecosystems to survive disturbances and adapt to changing conditions" (Capra, 1996, p. 302). In human communities, cultural and ethnic diversity and a balanced, flexible approach to social stress and conflict resolution enact these ecological principles. Through understanding and living according to ecological

principles, Capra suggests human communities might achieve sustainability, ensuring the survival of humanity.

In defining ecological literacy, Capra and Orr emphasise the ecological, glossing over the notion of literacy. For Stables (1996; 1998), Stables and Scott (1999), and Stables and Bishop (2001), the notion of ecological *literacy* implies a connection with reading and writing—with text. This notion translates into a conception of environment *as* text. Stables (1996) contends that, though we may readily conceive of ecological literacy in terms of understanding and making sense of the environment, we should explore further the idea of environment as text. He argues that "'environment' is, at least in part, a social construct and that textual studies offers a valid means of studying it" (p. 189). Stables' (1996; 1998) premise for his argument of environment as a social construct rests on the notion of human-environment interaction or actions determined by human values and cultural norms. These values and norms change relative to society or culture and time. In this vein, he argues that the environment has symbolic and moral connotations and meaning as well as a physical existence (Stables, 1996). Thus, based on the work of Saussure (1959), signs or symbols that signify meaning (semiotic) in some form constitute 'text' (Stables & Bishop, 2001). And, in turn, texts are read. Stables (1996) states, "we 'read' the environment as part of a complex process of generating and responding to texts. Our responses to environment form an element in the network of shared meanings which embodies society" (p. 192).

The concept of environment *as* text is also expressed in the writing of Golley (1998). Golley states in his introduction, "the landscape is a text that informs us about its capacity to produce and support life, its history, and what organisms are likely to be

present" (p. ix). The possibility and notion of environment as text is implicit within other authors' works, particularly in terms of our interrelationship with nature, environment or Earth (cf. Abram, 1996; Kahn, 1999; Orr, 1992). I will come back to this notion of environment as text later in this chapter as I develop my theoretical framework.

If we accept Stables' (1996; 1998) conception of environment as a social construct and, accordingly, as text, then we must recognise significance and potential meaning inherent within the biophysical environment (Stables & Bishop, 2001). As well, we must recognise that the biophysical world is intertwined with our perception of it and, consequently, that environmental issues are open to interpretation (Abram, 1996; Stables & Bishop, 2001). This conception of ecological literacy allows for and encourages multiple perspectives or views of the environment, including the cultural and aesthetic, extending and broadening the conception of environmental thought and education beyond the dominant, western scientific view (Stables & Bishop, 2001). This broadened conception allows for different views of and responses to environmental issues and for alternative ways of understanding the environment. As well, the textual/literacy notions of *reading* and *writing* equate to 'responding to' and 'acting on' the environment. Consequently, 'taking action' is inherent within the concepts of ecological literacy and environment as text (Stables & Bishop, 2001).

Stables and Bishop (2001) argue that this broadened conception of ecological literacy (i.e. literacy as semiotic engagement and environment as text) is not a component *within* environmental education, but rather subsumes environmental education, providing an overarching conceptual framework. As a conceptual framework, I believe it has

significance, particularly in shaping or reshaping our thinking and relationship with our environment and the more-than-human world.

Stables (1998; 2001) describes literacy skills (i.e. print-based literacy) as functional, cultural, and critical literacy. He relates this conceptual framework of literacy to the environment in terms of functional, cultural, and critical *environmental* literacy (Stable's terminology). This tripartite division is not new to discussions on the subject of literacy. In a review of the literature concerning scientific literacy, this division is evident. For example, Norris and Phillips (2003) focus primarily on a discussion of scientific literacy in its fundamental sense, that is, functional; Jenkins (1999) and Kolstø (2001) in the civic or cultural sense; and Hodson (2003; 1998) and Lemke (2002) in the critical sense. Other examples can be taken from discussions surrounding multiple literacies such as computer or media literacies. Green (1988) developed a 3D model for literacy that is essentially identical to the model employed by Stables (1998; 2001). Similarly, Scribner (1986) outlined three metaphors for a socially contextual literacy; literacy as adaptation, as power, and as a state of grace, which respectively compare to functional, critical, and cultural literacies. A tripartite focus on literacy—whether scientific, media, or ecological—helps to delineate a conception of literacy as a set of social practices involving multiple modes, carried beyond the normative view of reading and writing.

Beginning with the notions of functional, cultural, and critical *print* literacies, Stables (1998) defines what it means to be functionally, culturally, and critically environmentally literate. Functional environmental literacy refers to the ability to recognise, remember, and name components and systems of the environment, such as an

aspen tree or a boreal forest. It also requires the ability to extrapolate—to deduce what something might be or where it might fit within a system based on known properties or similarities. It requires a scientific understanding of foundational concepts related to land-water systems, ecosystems, and populations and communities (Capra, 1996; Golley, 1998). Consequently, "functional literacy is not ... a mere prerequisite to more advanced forms of literacy, but involves a series of complex skills and an accumulation of knowledge which has unlimited capacity for growth" (Stables, 1998, p. 158). Functional environmental literacy provides the foundation for cultural and critical environmental literacies and is most often the literacy learned in school science education. However, functional literacy alone is not enough. "Functionality without cultural sensitivity and critical reflection is potentially as destructive as constructive, even if it is a functionality that takes some account of, say, resource management and social and environmental consequence" (Stables, 2001, p. 252). Knowing about the environment, ecology, or Earth systems does not guarantee environmentally responsible behaviour—for that to occur, values and a sense of connection and place are essential (Gruenewald, 2003; Nabhan & Trimble, 1994; Thomashow, 2002).

Cultural environmental literacy, based on the cultural literacy work of E. D. Hirsh and Allan Bloom (see King, 2000), refers to the ability to recognise and understand the societal significance and importance attached to cultural icons (Stables, 1998). In terms of the environment, Western cultural icons might include the Canadian maple tree/leaf, the bald eagle or mistletoe. But cultural literacy is not limited to significance of icons, it also "allows for an understanding of why the landscape itself is as it is.... [and] enables us to explain why [natural things] are there when the causes are clearly not simply

geographical or climatic with no apparent human intervention" (Stables, 1998, p. 159). Inherent within this is the complex interplay of environments and ecosystems that have been shaped over great expanses of time through ancient human influences—influences we often no longer recognise. Central to cultural environmental literacy are values and the dominant value system—in other words, the context of place. Significance is culturally and socially dependent, as are social perspectives. Stables (1998) states, "insofar as cultural literacy is empowering, it empowers by giving the learner access to socially powerful perspectives; cultural literacy alone does not enable the learner to act upon that knowledge once acquired. Effective action requires critical literacy" (p. 159).

Critical environmental literacy is dependent on both functional and cultural literacies but goes that one important step further—the step that leads to empowerment, action, and change. In describing critical literacy, Lankshear and Knobel (2003) state, "the *critical* dimension involves awareness that all social practices, and thus all literacies, are socially constructed and 'selective': they include some representations and classifications—values, purposes, rules, standards, and perspectives—and exclude others" (p. 11). Critical literacy brings into question hegemonic power structures that act to marginalize certain groups in favour of the dominant few (Cadiero-Kaplan, 2002). For Stables (1998), critical environmental literacy depends on functional literacy for the knowledge required to intelligently question and discuss issues and make decisions based on sound information, understanding, and judgment. Critical environmental literacy also depends on cultural literacy to ground understanding in an awareness of the dominant culture's values and norms and their influences. However, an environmental education conceived in terms limited to functional, and possibly cultural, literacy is incomplete. The

importance of critical environmental literacy is powerfully and convincingly stated by Stables (2001):

> For the world to be worth living in, we surely need high levels of both cultural and critical environmental literacies in order that we can acknowledge that we live in an ecosystem, the future of which is dependent on our moral choices, feel empowered to act for the environment in ways that seem apposite and become better able to evaluate the effects of our, and others', actions with respect to the environment. (p. 253)

Stables (1998) recognises limitations of this tripartite model for ecological literacy, particularly as a practical conceptual framework for environmental education if taken too literally. He argues that there are obvious and crucial differences between reading the environment and reading print-based text. However, the tripartite model works as a framework for expanding and reconceptualising environmental education to include ethical, aesthetic, and cultural perspectives as well as scientific understanding of issues. And a broader and deeper scientific, cultural, and moral understanding has the potential to guide students towards critical reflexivity and action whereby students will ask "What will this actually mean for us/others/nature?" (Stables, 1998, p. 160).

A further limitation or criticism respecting the concept of ecological literacy centres on the notion of critical literacy. Bowers (1993) suggests that being *critical* is interpreted or viewed in terms of rationality and a stepping back or detachment, and this he sees as problematic for ecological literacy. He argues that this outsider view or detachment inherent within rationality and critical faculty is essentially antithetical to ecological literacy and its commitment to connection and place. Bowers (1996; 2004)

further argues that a critical pedagogy is rooted in Western cultural assumptions of anthropocentrism, linear progress, and the individual as the basic social unit—in other words, in an entirely sociological view that does not consider an ecological connection. In this sense, Bowers is correct. However, Gruenewald (2004) argues, "Bowers's repeated rejection of critical pedagogy ... neglects elements of critical discourse that might be useful in working toward his ecojustice vision" (p. 103). Critical ecological literacy offers an interpretation and language for fostering a questioning attitude and awareness foregrounding environmental action and ecological responsiveness. Being critical asks that we question what (or who) is left out and whose interests are being served. Presently, I intend to explore what is being hinted at here—the need for a theory that encompasses both a sociological and ecological perspective highlighting the interrelatedness of the two.

Other limitations of the tripartite model for ecological literacy centre on disagreement, or potential for disagreement, regarding the definition and interpretation of ecological literacy. For example, King (2000) argues that deep ecologists, eco-feminists, social ecologists, or mainstream environmentalists have different visions of the cognitive and aesthetic skills necessary for ecological literacy. However, I suggest that this is neither surprising nor new. Concepts as encompassing as ecological literacy are bound to be at least somewhat ambiguous and beg definition. Scientific literacy is similarly disposed to ambiguity and disagreement (cf. DeBoer, 2000; Hodson, 2003; Kolstø, 2001; Laugksch, 2000; Norris & Phillips, 2003).

Despite its limitations, I believe ecological literacy has the potential to provide a more holistic, reconceptualised framework that is crucial, not only for environmental

education, but for education in general. "The world to be worth living in" (Stables, 2001, p. 253) is no light matter. Therefore, we must conceive of environmental education in such a way as to foster ecological literacy.

An Ecological Literacy Curriculum: Reconceptualised

> At the very least we need to be aware of the attitudes towards the environment that the whole experience of schooling communicates to children, and to consider seriously whether we should remain content. But, more than this, many of the issues invite a profound reappraisal of conceptions of knowledge, human consciousness and what counts as an adequate relationship with the world, upon which any conception of education must be premised. (Bonnett, 1997, p. 263)

Bonnett is calling for a reconceptualisation of education that examines what has come before; one in which we question our notions of human understanding and our relationship with nature, the environment, and, ultimately, the world. Similarly, Bowers (1997; 2001) and Greene (1995) ask that we become aware of and question the dominant ideologies that maintain the status quo, ideologies such as progress and consumerism and an anthropocentric worldview. Critical literacy is essential if we are to question the dominant ideologies and reframe our relationship with Earth (Carlson, 1995; Stables & Scott, 1999). Through critical ecological literacy, students are empowered to examine past histories and ideologies that have led to our current ecological crisis and to question the direction humans are headed (Stables, 2001; Stables & Scott, 1999). As ecologically literate people, their questions can be framed within an informed and holistically relational position. This relationship is key to forming an ecological perspective framed by a sense of history, complexity, interconnectedness, and place, and it is this relationship

that seems to be missing from education (Gruenewald, 2003; Krapfel, 1999; Orr, 1992; Thomashow, 2002). Grumet (1995) states that "what is basic to education is neither the system that surrounds us nor the situation of each individual's lived experience. ... [it] is the relation between the two" (p. 16). So how do we build this relation? What is it we need to do to reconceptualise an education that fosters an ethical, caring, relational, and ecologically literate perspective?

Curricular frameworks for environmental education have traditionally conceived of environmental education as subject matter integrated within the science disciplines or as a discrete subject or discipline (Simmons, 1989). However, Bonnett (1997), Orr (1992), Stables (1996; 2001) and Stables and Bishop (2001) argue for a reconceptualisation of environmental education to one that goes beyond even a cross-disciplinary approach. Stables (2001) argues for a "within-disciplinary" approach and Bonnet, drawing upon the work of Orr, suggests "there is an important sense in which we must regard *all* education as environmental education. We must examine the attitudes and understandings that are engendered across all aspects of the curriculum and school experience from an 'environmental' perspective" (p. 250). A curriculum that embraces ecological literacy offers a "coherent framework for developing differing kinds of environmental awareness within existing disciplines" (Stables & Bishop, 2001, p. 96). If our hope is to foster a caring, relational, ethical, and responsible attitude and value system towards Earth and all her inhabitants, one in which knowledge and understanding are carried over into actions, then a curriculum framework that includes ecological literacy in all its aspects is essential.

Notions of Sustainability

A discussion of ecological literacy and curriculum would not be complete without a brief foray into the notion of education for sustainable development, particularly in light of the UNESCO (2005) Decade of Education for Sustainable Development (2005-2014). The United Nations Conference on the Human Environment (Stockholm, 1972) began a global awareness and focused attention on environmental issues and concerns. As a consequence,

> the global community acknowledged that more exploration was needed of the inter-relationships between the environment and socio-economic issues of poverty and underdevelopment. Thus the concept of sustainable development emerged in the 1980s in response to a growing realisation of the need to balance economic and social progress with concern for the environment and the stewardship of natural resources. (UNESCO)

Therefore, many educators argue for environmental education to be conceived in terms of education for sustainable development (e.g. Mayer, 2005; Rauch, 2002). However, alongside this idea sits the argument concerning the notion of sustainable development—debate centred on the incongruent nature of the language of 'sustainable' *in conjunction with* 'development' and the intrinsic difficulties and limitations this presents (Bonnett, 2002; Desinger, 1990; Fien, 1993b; Jickling, 2001; Orr, 1992; Sauvé, 2002; Stables & Scott, 2002). This difference of opinion suggests the importance of being aware of language and how language constructs social meaning.

The Import of Language

Tired of all who come with words, words but no language

I went to the snow-covered island.

The wild does not have words.

The unwritten pages spread themselves out in all directions!

I come across the marks of roe-deer's hooves in the snow.

Language, but no words.

– Tomas Tranströmer (In Abram, 1996, p. 137)

Tomas Tranströmer's poetic verse conveys a close and intimate relationship with nature—an ability to 'read' and comprehend the language of nature. The role and power of language in shaping our relationship with nature should not be underestimated. According to Vygotsky (1934/1986), language is essential to thought—thought and language are interrelated within a social, historical and cultural construct. Thus, our thought and, to a large extent, our perceptions of the world are determined by our language and culture. Merleau-Ponty (1962) goes beyond the social view of language and perception to include the physical world, suggesting that human language and perception is embodied in the physical world, rooted in our physical engagement in our environment (Abram, 1996; Davis, 2004). Abram (1996) summarises Merleau-Ponty's understanding of language:

> The complex interchange we call "language" is rooted in the non-verbal exchange always already going on between our own flesh and the flesh of the world. Human languages, then, are informed not only by the structures of the human body and

> the human community, but by the evocative shapes and patterns of the more-than-human terrain. (p. 90)

Language is fundamental to our conception of and relationship with nature or the environment (Östman, 1994). What is more, language is fundamental to ecological literacy, particularly within a cultural context. Our moral, ethical, and aesthetic relationship with the environment is entwined with our language and our conceptual awareness is reflected in the metaphorical language we employ.

Language and Metaphor

Metaphorical language is powerful in shaping our thoughts and our conceptions of environment and, accordingly, our human role and relationship. Metaphors can "affect what we believe, who we are, and the kind of society we live in and are part of" (Kilbourn, 1998, p. 25). Metaphors are also often the easiest, and sometimes only way to understand abstract concepts (Lakoff & Johnson, 1980). The conceptual understanding of our relationship to and place within a complex ecosocial system commonly rests on metaphorical language. Similarly, many environmental issues, such as climate change and ozone depletion, are complex, abstract, theoretical constructs that are concretized through metaphor (Väliverronen, 1998). However, metaphors do more than help explain and further understanding. Burke (1989) describes metaphor in terms of perspective; "metaphor is a device for seeing something in terms of something else. It brings out the thisness of that or the thatness of this" (p. 247). Consequently, metaphor places something, whatever that something may be, in a particular light (Dryzek, 2005; Väliverronen, 1998). Metaphor's situational role in perspective, creates a duality—

something may be revealed and also hidden (Väliverronen, 1998). In this way, metaphors are closely connected to the production of companion meanings (Kilbourn, 1998).

Companion Meanings

In collaboration with Östman, Roberts' conception of curriculum emphases in science education led to the development of the expanded notion of companion meanings, notably in terms of discourse and text (Östman, 1994; Östman, 1998; Östman & Roberts, 1994; Roberts, 1995, 1998). Roberts (1998) states "curriculum emphases represent coherent clusters of messages about science that are deliberately, intentionally interwoven with science subject matter in order to socialize students in selected directions" (p. 10). However, companion meanings include not only the deliberate or policy driven meanings, but also "the not-so-deliberate (but still very real ...) "extra" meanings that accompany scientific meaning, in curriculum and textbook as well as in teaching" (p. 11). Companion meanings are embedded in discourses through *what* is said or not said and through *how* it is said or not said (Östman, 1998). Meaning is produced dialogically (Bakhtin, 1953/1986)—"what *is* said in relation to what *could have been* said, how it *is* said in relation to how it *could have been* said" (Östman, 1998, p. 55).

Drawing upon the dialogical meaning inherent within discourses, Östman (1994; 1996; 1998) describes the concepts of a 'nature language' and 'subject focus'; two category systems useful for revealing companion meanings communicated in science texts. Nature language employs discourse rules or discursive practices and root metaphor(s) (or a blend of different root metaphors) to govern the use of language *about* nature, conceptualising reality and constructing a particular view of nature. Östman delineates four categories of nature language: *Classical*, *Biomechanistic*, *Ecomechanistic*,

and, added by Östman in 1998, *Organicist.* Classical and Organicist represent opposite extremes, with Biomechanistic and Ecomechanistic blends of the two (see Table 1).

Table 1
Östman's (1994, 1996, 1998) view of nature or nature language

	Classical	**Biomechanistic**	**Ecomechanistic**	**Organicist**
	← continuum from Classical (mechanistic) to Organicist (holistic) →			
Discourse Rules	Mechanistic, deterministic, atomistic Objectified approach (nature is an object/thing separate from humans and human values)	Life functional ideas used (nature functions to support life) but Classical notions and language predominant	Ecologically oriented form of Classical language Holistic views are articulated alongside atomistic and mechanistic but organicist language dominant	Interconnected, holistic language Ecological/systems perspective (nature is understood relationally, i.e. parts understood in relation to the whole; phenomena understood in relation to other phenomena)
Root metaphor(s)	Root metaphor: machine	Metaphorical blend: view that nature functions as a machine *and* its purpose is to create and maintain life	Metaphorical blend: Nature is a self-regulating whole that can be explained by mechanistic/atomistic reasoning	Root metaphor: integration/whole

The concept of subject focus is concerned with the discourse and language around the *relationship* between human beings and nature. How teachers (or texts) describe and/or use nature in science classrooms communicates a certain view of this human-nature relationship, ascribing a value to nature and our consequent moral responsibility (Östman, 1994, 1998; 1996). Drawing from the work of Fensham (1988), Östman delineates two primary categories of subject focus: *Induction into Science* and *Learning from Science.* The *Induction into Science* subject focus views nature simply as an educational tool or instrument for teaching students science concepts; no moral

obligations are associated with this particular stance. Within *Learning from Science*, science is a means for describing and explaining nature and natural phenomena, essentially the reverse of the *Induction into Science* subject focus. Östman further distinguishes four subject foci within *Learning from Science*: *Exploitation of Nature*, *Human Being as Threat*, *Survival of Homo sapiens* and *Preservation of Nature* (see Table 2). Each subject focus carries with it a particular concept of nature together with a vision of the relationship between human beings and nature—or a vision of what that relationship ought to be (Östman). Östman's descriptors become a tool for analysis; a means for exploring and describing the discourses of school science texts and/or classroom dialogue that act to shape a particular view of nature and human-nature relationship.

Table 2
Östman's (1994, 1996, 1998) human-nature relationships or subject foci

Exploitation of Nature	Human beings have used or can use nature to promote their material welfare; nature is a resource for exploitation by human beings and we have no moral responsibility in that respect.
Human Being as Threat	Human beings are threatening themselves and other living organisms; language used does not ascribe value to nature; communicates the idea that human beings have no moral responsibility or obligation when dealing with nature.
Survival of *Homo sapiens*	Humans should take a responsible attitude towards nature insofar as the survival or well-being of other human beings could be at stake; anthropocentric or human-centred ethical argument.
Preservation of Nature	Humans should take a responsible, duty-based attitude towards nature; nature has intrinsic value which we do not have the right to violate; bio-centric or nature-centred ethical argument.

Östman (1994; 1996; 1998), embodying an ecocentric and ecological worldview in his teaching and writing, believes classroom experiences (including experiences with text), social interactions, and especially language and metaphor, have the power to shape knowledge construction, student identity and an environmental consciousness. Further,

Östman (1994) suggests that teaching science is a moral act. Thus, "[as teachers] our choice of content has to take moral consequences into account, specifically acknowledging the view of nature and of human beings' relationship to nature, which are produced by such a choice" (p. 142). However, I would suggest that teachers are not necessarily cognisant of the 'content' of curriculum resources in terms of hidden or companion meanings nor are they aware of the root metaphors embedded in the language of these resources, root metaphors that act to govern the language of nature and shape the human-nature relationship. This notion is supported by Van Matre (2001); he states, "many well-meaning teachers ... don't know the real origins of the material they have been given or understand how insidious those materials are in conveying a consumer-oriented, exploitive world view (often in what they leave out of their explanations and examples)" (para. 3).

Root Metaphors

Kilbourn (1998), drawing upon the work of S. C. Pepper (1942; 1945), explores the notion of root metaphors and their connection to companion meanings and science education. Pointing to the underlying power of metaphor, Kilbourn eloquently states,

> Root metaphors are, in a way of speaking, metaphors of possibility—they give rise to ways of thinking about the world and ways of being in the world. They, at once, extend and limit our conceptions of what is, what is beautiful, what is possible, and what is right to do. (p. 36)

Kilbourn describes four worldviews (or world hypotheses in S. C. Pepper's terminology), each of which is coupled with a root metaphor and which relate deeply to ontological conceptions of truth and aesthetics. The four worldviews and their root metaphors are:

1) formism—similarity; 2) contextualization (pragmatism)—active present or changing situation; 3) mechanism—machine; and 4) organicism—integration.[4] Of particular relevance to my research and to science, ecology and environmental education are the third and fourth worldviews, mechanism and organicism, and their accompanying root metaphors, machine and integration.

Mechanism

For the past several hundred years (since the time of Descartes and Newton), the dominant language and metaphor of Western culture has its roots in the machine reflecting a mechanistic and anthropocentric worldview, one which values linear progress and Western modernist thinking (Abram, 1991; Bonnett, 1997; Bowers, 1997; 2001; Capra, 2002; Harré, Brockmeier, & Mühlhäusler, 1999; Kilbourn, 1998; Stables & Scott, 1999). Alongside this lies a mechanistic aesthetic that is essentially hedonistic and highly individualistic (Kilbourn, 1998).Within a mechanistic and anthropocentric worldview are several explicit and implicit assumptions. The Earth as machine implies a world that is predictable and reducible to its parts (Abram, 1991; Kilbourn, 1998). Essentially, with the 'right' tools and given enough time, human kind will be able to 'discover' all of Earth's workings and, when necessary, 'fix' any problems. The superiority of science and technology and unrestrained human progress is inherent within this worldview (Bonnett, 1997). "When nature is projected as a vast machine ... it is set up as essentially 'soulless' and thus devoid of any intrinsic moral standing" (Bonnett, 1997, p. 251)—this justifies the 'might as right' stance.

[4] For further explanation of formism and pragmatism and their associated root metaphors, see Kilbourn (1998).

In addition, implicit within a mechanical metaphor is the metaphysical notion of a maker or builder. In the seventeenth century, this notion allowed for a separation of church and science—scientists were merely trying to uncover the workings of God's creation. This assumption points to the inference of a superior and arrogant human species, one 'made in God's image'. Abram (1991) states,

> The mechanical metaphor ... not only makes it rather simple for us to operationalize the world, by presenting nature as an assemblage of working parts that have no internal relation to each other—a set of parts, that is, that can be readily taken apart or put back together without undue damage; it also provides us with a neat justification for any and all such manipulations. (p. 68)

The mechanistic and anthropocentric metaphor has led to a severing of our interconnectedness and relatedness with Earth. The tenets of ecological literacy call for a reconnection with Earth—an engagement with our environment in an ethical, aesthetic, scientific, historical, and moral manner (Stables, 2001; Stables & Bishop, 2001).

Organicism

The worldview of organicism and its accompanying root metaphor of integration offer greater possibilities for humans to reconnect with Earth and become ecologically literate. Unlike mechanism, which views the world as parts, organicism views the world in terms of complex, integrated, self-organizing wholes (Capra, 1996; Kilbourn, 1998). The notion of the interconnectedness of all forms and events underpins organicistic and systems thinking and, similarly, is the basis for the field of ecology (Kilbourn). An organicistic or ecological view is concerned with questions of meaning and attentiveness to situation or context (Davis, 2004). And, according to Kilbourn, "organicist aesthetics values the

integration of feelings" (p. 33). As a consequence, organicism is deeply concerned with ethics and ethical action (Davis) and is, thus, closely connected to critical ecological literacy.

As teachers and educators, we must be particularly aware of the language and metaphors invoked in our classrooms—those we use personally or incorporate from curriculum materials—if we desire to foster thought that engenders an ethical, responsible, ecologically literate relationship with nature and the environment. We must be cognisant of the hidden or companion meanings as well. As Bowers (2001) says, "language carries forward and reproduces ... the teacher's taken-for-granted thought patterns. ... [A] lack of awareness on the part of most scientists, environmental educators, and experts who produce curriculum materials of the metaphorically layered nature of language ... carries forward earlier culturally specific ways of thinking" (p. 142). What is the 'metaphorically layered nature of language' in the environmental curriculum resources produced in Alberta by the various interested parties? What 'culturally specific ways of thinking' are carried via these resources and the language contained within as they are utilised in Alberta elementary classrooms, constructing interrelated, dialogical discourses of science, ecology, environment, and our human-nature relationships?

Ecological Discourses

Lemke (1995) broadly defines discourse as "the social activity of making meanings with language and other symbolic systems in some kind of situation or setting. [This includes] the participants in the discourse, whether they are considered actually present in or only potentially relevant to the situation" (p. 6). Dryzek (2005) describes discourse as "a shared way of apprehending the world" (p. 9). Accordingly, as socially

and culturally shared contexts of meaning, discourse extends beyond language (Harré et al., 1999). However, language is recognized "as the most significant and dominant 'psychological tool' in the business of human meaning-making" (Harré et al., p. 4).

Dryzek (2005) argues, as does Lemke, that "discourses are bound up with political power" (p. 9). Drawing upon Foucault, he suggests, "discourses can themselves embody power in the way they condition the perceptions and values of those subject to them, such that some interests are advanced, others suppressed" (p. 9). As such, the significance of a critical perspective with regard to discourse becomes readily apparent.

From the above discussion on discourse, *ecological* discourses, then, centre on the cultural and social ways in which we speak or write to construct meaning in relation to nature, ecology, and the environment. They are constructed, in large part, through their innate root metaphors. There are political ramifications associated with these discourses—"language matters ... the way we construct, interpret, discuss, and analyze environmental problems has all kinds of consequences" (Dryzek, 2005, p. 10). As Davis (2004) suggests, ecological discourse, as a conceptual orientation, "might make a different sense of the relationship of the human to the more-than-human world" (p. 150). This notion of ecological discourse has significance for ecological literacy and becomes crucial to the construction of an ecosocial theory—one that helps bridge a human-centred social theory of language and discourse with ecological perspectives.

Language, Discourse, and Ecosocial Theory

Thus far, my review of the literature has been building towards the construction of a theoretical perspective within which to frame my research. To do so, I intend to primarily draw upon the writing of Lemke (1995: 2001). Lemke (1995) argues, "we

cannot be understood apart from our connections to our social and material [physical] environments ... nor outside a view of the multiple levels of self-organization of systems larger and smaller than 'us'" (p. 94). Accordingly, Lemke integrates sociocultural theories and perspectives with ecological and systems thinking to construct an *ecosocial* theory. Other writers, such as Thibault (2004a; 2004b) and Salthe (2003) draw upon Lemke's notion of ecosocial theory in their own work. Along similar lines of thought, Capra (2002) marries social theory with complexity theory in order to construct "a unified view of life, mind and society" (p. xv).

I propose that an ecosocial theory offers the possibility for integrating sociocultural notions of human discourses and texts with the notion of environment as text. In this way, we may recognise that the more-than-human world (or at the very least our perspective of and dialogical relationship with this world) is socially constructed, and as such, the environment becomes a semiotic resource for meaning-making. An ecosocial theory provides an overarching lens with which to try to understand "how and why people make the meanings that they do" (Lemke, 1995, p. 156) as I explore the discourses in environmental science texts and their production.

I begin with a brief discussion of the social theories that frame the development of an ecosocial theory and then explore ecological and systems perspectives that are integral to an interconnected ecosocial theory.

Social Theories and Discourse

Social theories are useful if they help us understand and explain how and why social systems arise and act as they do; how communities change or remain static for periods of time; how power is exercised and consequent social injustices occur and are

maintained; and how discrete social events connect to form broader, complex patterns of social interactions and relationships—patterns which persist and repeat (Lemke, 1995). Similarly, a useful social theory of discourse needs to help us understand how discourse and language, the meaning-making tool of discourse, along with semiotics and patterns of action shape communities, constructing those connections between discrete social events and larger social systems (Lemke). Lemke draws on the work of Mikhail Bakhtin, Michael Halliday, Michel Foucault, and Pierre Bourdieu in order to construct a comprehensive and eminently useful social theory of discourse. I intend to only briefly sketch the salient points of each of the above authors' contributions to an ecosocial theoretical construction.

I begin with Mikhail Bakhtin (1935/1981; 1953/1986), as his work is central to understanding discourse as a "*social event*" (Lemke, 1995, p. 22). Lemke focuses on Bakhtin's notions of *utterance*, *dialogic*, and, especially, *heteroglossia*. For Bakhtin, the fundamental element of language is the utterance—a social event or "moment of discourse" (Lemke, p. 22). Bakhtin believes that all understanding occurs in response to another living person—language is relational.

> The actual reality of language/speech is not the abstract system of linguistic forms, nor the isolated monologic utterance, nor the psycho-physiological act of its implementation, but the social event of verbal interaction implemented in an utterance or utterances. (Volosinov, 1929/1973, p. 94)

The meaning of an utterance, of this social event, can only be determined in relation to other utterances. This is because "the utterance always originates in and functions as part of a social *dialogue* (whether the participants in this dialogue are considered to be

actually present or are only implied)" (Lemke, p. 23). Bakhtin suggests that the meaning of an utterance is only understood in contrast to other thematically similar utterances. "Utterances are not indifferent to one another, and are not self-sufficient; they are aware of and mutually reflect one another.... Every utterance must be regarded as primarily a *response* to preceding utterances of the given sphere" (Bakhtin, 1953/1986, p. 91). Lemke describes Bakhtin's particular view of meaning as the "principle of intertextuality" (p. 23). The meaning of an utterance or discourse emerges from the relationship between utterances/discourses set against the background of other similar discourses, social events, or relevant texts. "The notion of the *utterance* for Bakhtin is a bridge between the linguistic and the social, the event-meaning and the larger social systems in which that event has its meaning for us" (Lemke, p. 23).

From the utterance, Bakhtin developed a *dialogical* view of discourse—"as always speaking against the background of what others have said or written in other times and places" (Lemke, 1995, p. 23). Bakhtin recognised that, though our utterances are our own, they are not isolated from other related utterances. They are contextual and bounded by our social groups; different between people of diverse social positions and from different places and times. Bakhtin referred to these as distinct social voices or "social languages of *heteroglossia*" (Lemke, p. 24). Bakhtin (1935/1981), in describing the "languages of heteroglossia," states,

> ... [they] are specific points of view on the world, forms for conceptualizing the world in words, specific worldviews, each characterized by its own objects, meanings, and values. As such they may all be juxtaposed to one another,

mutually supplement one another, contradict one another, and be interrelated dialogically. (p. 291-2)

Lemke refers to Bakhtin's social voices or heteroglossia as "*discourse formations* ... the persistent habits of speaking and acting, characteristic of some social group, through which it constructs its worldviews: its beliefs, opinions and values" (p. 24). As individual members of some social group or community, the ways in which we make sense of the world (the discourse formations we use) are always in relation to the discourse formations of the group. "We speak with the voices of our communities, and to the extent that we have individual voices, we fashion these out of the social voices already available to us, appropriating the words of others to speak a word of our own" (Lemke, pp. 24-5). This notion is key in recognising and making explicit the worldviews—the beliefs, opinions and values—constructed by the discourses of the various environmental science resources and their producers/writers.

Recognising the intertextual, heteroglossic, and dialogical nature of discourse, Lemke (1995) turns to Michael Halliday (1977; 1978) to further explore theories around *how* intertextuality occurs, how different social voices occur, and about the relations between the discourses of various social groups and within groups. In particular, Lemke is interested in Halliday's theory of *register*.

Halliday, a British linguist, was aware of the language differences between social groups or communities Bakhtin referred to as social voices (heteroglossia). However, Halliday looked more specifically at linguistic differences in terms of different activities—the differences between, for example, the language of sports, mathematics, politics, or science (Halliday, 2004; Halliday & Martin, 1993). He saw these as different,

> ... not simply in their vocabulary, and not simply because these uses of language are more likely for people in some social position or other, but because the frequencies of occurrence of many grammatical and semantic features in these texts were skewed by the nature of the different activities in which the language was being used. (Lemke, 1995, p. 26)

This formed the basis of Halliday's theory known as register. Register describes the functional kinds of language peculiar to specific activities, delineated by various textual, grammatical, and semantic features. Out of this grew Halliday's Systemic Functional Linguistics (SFL) (cf. Halliday, 1985; Halliday & Matthiessen, 2004), a functional approach to language and grammar in view of social relations and communication (Fairclough, 2003; Gee, 1999, 2006). As Lemke states, "Halliday's social theory of discourse suggests that our own uses of language are inseparable from the social functions, the social contexts of actions and relationships in which language plays a part" (p. 27). In this way, language is seen as a tool for social purposes, as a "*social semiotic*" (Lemke, p. 27). It serves to link the utterance (or text) to the social system, that is, the community.

The theories of Bakhtin and Halliday began with language, examining how language and discourse function within the wider social system. Michel Foucault, on the other hand, began with the social system, turning to discourse as an analytical tool for explaining our present day continuity and discontinuity with the past (Lemke, 1995). Foucault was concerned with the ways in which discourses—in wider social structures and in narrower local situations—construct, position, and define people (Luke, 1995).

Lemke draws upon the work of Foucault (1966; 1969) to further explore the general principle of intertextuality and Foucault's notion of *discursive formations*.

As a historian, Foucault "sought to build a general model of how our picture of the past, of our continuities and discontinuities with it, depends critically on our sense of the possible ways in which texts can be combined" (Lemke, 1995, p. 29). In terms of social history, Foucault was constructing the notion of *intertextuality*—the context bound relation between texts. Describing the concept of intertextuality, Lemke (1998a) states, "the meaning of any text or discourse event always depends on how we connect it to some (and not other) texts and events" (p. 1177). Tied to the notion of intertextuality and its emphasis on the contextual relationships between texts, is Foucault's concept of discursive formations. Discursive formations are systems formed from statements (utterances) that "tend to be used together in certain typical patterns (discursive practices)" (Lemke, 1995, p. 30). Concerned with social change and *how* it occurs, Foucault recognized that an historian's view of (response to) text becomes part of the discursive formation, functioning in the process of change. Foucault identified 'rules' for how statements can be used in different contexts relative to other statements. Lemke describes Foucault's 'rules' for discursive formations:

> A discursive formation ... is defined by four kinds of relations among statements: those which determine what sorts of discursive objects (entities, topics, processes) the discourse can construct or talk about; those that specify who can say these things to whom in what contexts; those that define the relations of meaning among statements, including how they can be organized to form texts; and finally those that tell us what the alternative kinds of discourses are that can be formed in

these ways and how they can be related to each other as being considered equivalent, incompatible, antithetical, etc. (p. 30)

Foucault's discursive formation, though not entirely equivalent to the linguistic discourse formation, helps to link or bridge texts with social systems. Foucault's rules and his theory of discursive formations add strength to a social theory of discourse.

Finally, I turn to Pierre Bourdieu for, as Lemke (1995) states, "the theorist who has made the fullest effort to provide a general theory of how people of different social categories acquire their social habits ... is probably Pierre Bourdieu" (p. 31). Lemke draws upon the work of Bourdieu (1977; 1990), as he has that of Bakhtin, Halliday, and Foucault, to construct a social theory of discourse that helps us understand how "different [discourse] formations (codes, genres, registers, voices of heteroglossia, discursive formations) are not just different .... They have systematic relations to one another, and those relations define and are defined by ... larger social relationships" (Lemke, p. 32). Lemke incorporates Bourdieu's theory of social *habitus* as another piece of the puzzle.

Bourdieu's *habitus* theory tries to explain the physical, embodied habits members of different cultures/communities acquire—people not only talk differently, they *walk* differently (Lemke, 1995). Bourdieu (1977) calls these "patterns of posture" the body *hexis* (p. 87). He describes the body *hexis* as, "*em-bodied*, turned into a permanent disposition, a durable manner of standing, speaking, and thereby of *feeling* and *thinking*" (p. 93-4). Bourdieu rejects the Cartesian mind-body divide;

> He takes something usually thought of as belonging to the domain of the 'mind': how we perceive things, how we feel about them and react to them, our habits and preferences and attitudes and dispositions to action (including to discourse) and

> makes them matters of the *body*. ... He speaks of culture as directly embodied in persons. (Lemke, p. 33)

Further, (and I think this is central to moving towards an *eco*social theory) Lemke states,

> We acquire these dispositions in the course of living our lives, interacting with the social and material (especially the human-made) environment, which consists of other people acting out of these dispositions and the material effects of such actions in the world. (p. 33)

All people do not achieve the same habitus—lives and experiences are different—but the more similar the life, the more alike the dispositions of the habitus. I envision Bourdieu's concept of social habitus as a bridge, not only between particular texts/discourses and larger social systems, but also as a possible bridge between social theory and ecological perspectives.

Lemke's (1995) interweaving of social theories from Bakhtin, Halliday, Foucault, and Bourdieu constructs a more comprehensive social theory of discourse whereby the whole becomes greater than its parts; a theory that recognises the historical, dialogical and embodied function of language and discursive practices. In constructing this theory, Lemke suggests areas in need of further inquiry and theorizing; particularly the role discourse and power plays in constructing a social order and the effects of the material world on meaning-making practices. Next, I turn to an exploration of ecological and systems thinking and how these perspectives inform an ecosocial theory.

Ecological Perspectives

An ecosocial theory considers social theory in light of ecological perspectives. We are not isolated human beings, separate from the natural world. We are at once

complexly interconnected with the physical world. Consequently, an ecosocial theory helps to answer questions around how our place, our identity, our dispositions and discourses shape and are shaped by the social as well as the physical or material world. Ecological perspectives as well as human/social perspectives inform an ecosocial theory.

Merleau-Ponty sought to bridge the divide between language, social action and the physical, non-verbal world (Davis, 2004). Davis states, "Merleau-Ponty suggested ... that human interpretive systems, including language, are rooted in and conditioned by our primal engagements in the world. ... [He] advocated attentiveness to both the cultural and the biological" (p. 146-7). Along similar lines, Lemke (1995) suggests that human social actions (as the basis of human social systems) have "both a material, ecological aspect and a cultural, semiotic one. ... [That] underlying them are the interconnected doings, the ecological and social processes that link organism to organism, and organisms to environments" (p. 93-4). Merleau-Ponty's and Lemke's notions of the interconnectedness of the cultural/social and biological/ecological forms the basis for the construction of an ecosocial theory—a theory that recognises ecological perspectives and the complexity of human systems operating within the larger world.

An ecosocial theory is informed by systems thinking and complexity. Briefly, systems thinking is recognised by a shift from a reductionist or mechanistic conception of phenomena to one that is organicist, whereby the whole can only be contextually understood in terms of the relationships of its parts (Capra, 1996). Systems, from the physical or material to human social systems, have common properties, behaviours and patterns which interact relationally. Complexity explores complex systems, recognising the importance of relationships between the parts and how these patterns of relations give

rise to collective behaviours or activities of a system. Complexity also recognises the interactions and relationships between nested, hierarchical systems and between systems and their environment (see Lovelock, 1990; Prigogine, 1980; Salthe, 1985, 1993). Complex systems are open, non-linear, dynamical systems that change over time (Lemke, 1995). They "are self-organizing, self-maintaining, dynamic and adaptive" systems (Davis et al., 2000, p. 55). Further, Davis (2004) states, "complexity science asserts that our knowledge systems are rooted in our physical forms—and that those forms, in turn, are engaged in ongoing cyclings of matter with all other living forms" (p. 156). It is this realization that informs an ecosocial theory.

Next, I return to Lemke (1995, 2001) and his conception of an ecosocial theory—a theory that integrates sociocultural theories of discourse with ecological perspectives, complexity and systems thinking.

Ecosocial Theory: Conceptual Framework

Lemke (1995) suggests "an ecosocial system is a human social community taken together with the material ecosystem that enables, supports and constrains it. ... An ecosocial system is simultaneously a material and social semiotic system" (p. 119). Lemke proposes three basic arguments for understanding ecosocial dynamics:

1. that human sociocultural systems are essentially systems of social practices linked in the historically and culturally specific semiotic formations from which they get their meanings;
2. that these practices are simultaneously material processes in a complex, hierarchically organized, developing and evolving ecosystem; and

3. that the interdependence between the semiotically and materially based couplings of these practices/processes is the basis of ecosocial dynamics. (p. 118-119)

In this way, human semiotic resource systems and processes, such as discourse and language, can be seen as relational to and part of material or physical semiotic resource systems and processes. These are not separate processes and systems, though we usually treat them as such. And it is by not viewing the social alongside the material that humankind has lost that sense of connection and awareness of how our physical world, the environment in which we dwell, shapes and is shaped by human cultural practices and processes. This suggests to me that it is then entirely conceivable to perceive the environment *as* text as suggested by Stables (1996) and Stables and Bishop (2001). An ecosocial theory helps me to understand how discourse and texts (literary and environmental) are shaped by our interaction and relation with the social and physical world, and in turn, dialogically shape our perspective of and relationship with that world; our ecosocial/ecological identity and consciousness.

My intention is to further construct and draw on an overarching ecosocial theory as the analytical work of my research proceeds. As Foucault (2003) said, this will require "an ongoing conceptualisation. And this conceptualisation implies critical thought—a constant checking" (p. 127). Thus, I envision my research informing theory just as theory underpins and strengthens my research.

The Place of Text

My research centres on environmental science texts produced for use in Alberta classrooms. Lemke (1995) states, "by examining the texts of our own community we can

come to understand how and why we make the meanings we do, and what other meanings might be made instead" (p. 79). Consequently, a necessary piece of this literature review is an exploration of the role text and textbook materials play in enacting curriculum, shaping experience, and, ultimately, identity. Apple (2000) contends,

> ... texts are not simply 'delivery systems' of 'facts.' They are at once the results of political, economic, and cultural activities, battles, and compromises. They are conceived, designed, and authored by real people with real interests. They are published within the political constraints of markets, resources, and power. (p. 44)

Texts are not neutral purveyors of knowledge—they act to construct a particular view of reality—someone's view. What counts as knowledge, culture, or beliefs is recreated and legitimated through texts (Apple). This can be achieved through what is said as well as what is not said, that is, companion meanings (Östman, 1998; Roberts, 1998), or through the "process of 'mentioning'" (Apple, p. 53). This process involves mentioning issues or topics, but not developing them in depth, thereby portraying a sense of lesser importance. As a consequence, the dominant perspectives are maintained (Apple). As discourses, texts can function ideologically, contributing to maintaining social relations of privilege and power (Lemke, 1995).

It is important to recognise, however, that readers interpret texts. Meaning is dialogically constructed between the producer and reader of any text; consequently texts are open to multiple readings. Additionally, it cannot be assumed that what is written in any particular classroom text is actually taught or interpreted by the students as either the writer or teacher intended (Apple, 2000). Nevertheless, texts are oriented towards a

specific audience. "These orientations involve value preferences; they commit ... to a political stance and a social point of view" (Lemke, 1995, p. 12).

In the preceding pages of this chapter, I have drawn on the work of many scholars, and in particular, on the work of Lemke (1995, 1998a, 2001) to situate my research within ecological literacy and curriculum, language, discourse and text (literary and environmental), sociocultural and ecological perspectives, and ecosocial theory. It is through this complex and interwoven lens that I now turn to methodological considerations.

CHAPTER 3: METHODOLOGY

Research Perspective

The design of my inquiry begins with the recognition that "methodology is inevitably interwoven with and emerges from the nature of particular disciplines ... and particular perspectives ..." (Lincoln & Guba, 2000, p. 164). My particular perspective is shaped and informed by my organicistic worldview, ecological identity and concern for the environment, and by my identity and experience as an educator and researcher. My position is critical—I question the underlying meaning, social stances, hegemonic ideologies, and possible corporatist agendas embedded in environmental science resources—curricular resources that effectively act to carry forth and shape identity and social practices. My methodology is therefore framed within a critical theorist discipline. And, accordingly, my inquiry is shaped by my understanding and views of discourse and language as situated in ecosocial theory. The importance of a social or, in this case, *eco*social theory to guide research should not be underestimated. Kincheloe and McLaren state (2000),

> In a research context [a social theory] does not determine how we see the world but helps us devise questions and strategies for exploring it. A critical social theory is concerned in particular with issues of power and justice and the ways that the economy, matters of race, class, and gender, ideologies, discourses, education, religion and other social institutions, and cultural dynamics interact to construct a social system. (p. 281)

My particular concern is with issues of power and influence and with the ways that ideologies and discourses interact to construct an ecosocial system—an interdependent,

relational system that includes not only human participants but the more-than-human as well. From an organicistic/ecological worldview, I can ethically do no other. And, as Hart and Nolan (1999) point out, "the dominant worldview is not the only view of reality or way of knowing ... we need to explore multiple frames of reference to more fully understand human-environment relationships" (p. 32-3). To this I would add—question such relationships.

I did not start out with the intent of working within the methodological field of critical theory, but as I began to question, more and more, the stances, perspectives and discourses of the various environmental curricular resources available for elementary science teachers, I began to see my thinking align with the views of many recognised critical theorists (cf. Apple, 2000; Fairclough, 1992; Kincheloe & McLaren, 2000; Luke, 1995). As a consequence, I have chosen to position my research and myself as researcher within a critical theory paradigm. According to Lincoln and Guba (2000), the framework of this paradigm "articulates an ontology based on historical realism, an epistemology that is transactional, and a methodology that is both dialogic and dialectical" (p. 160). Within this framework, reality is viewed as virtual, dynamically coalescing over time. Reality is shaped by cultural, political, social, economic, gender, ethnic, and, I would add, ecological values. A transactional epistemology is subjectivist, interactive, and mediated by values (Guba & Lincoln, 1994; Lincoln & Guba, 2000). The dialogical/dialectical methodology is relational, set against an historical background of opposing opinions and ideas (Lemke, 1995; Lincoln & Guba, 2000). This critical paradigmatic framework underpins my philosophy and research and an ecosocial theoretical perspective.

A critical theorist's concern is with the "social construction of experience" as influenced by ecosocial and historical "discourses and power relations"(Kincheloe & McLaren, 2000, p. 280). Guba and Lincoln (1994) state, "the aim of [critical theory] inquiry is the *critique and transformation* of the social, political, cultural, economic, ethnic, and gender structures that constrain and exploit humankind, by engaging in confrontation, even conflict" (p. 113). As a critical theorist, I am particularly concerned with the ecosocial, political, and historical forces that shape the decisions and actions of individuals and communities that "crucially affect their lives" (Kincheloe & McLaren, p. 282) as well as the existence of the more-than-human world.

Power relations and Antonio Gramsci's concept of cultural hegemony are important aspects of critical research. Kincheloe and McLaren (2000) state, "critical theory is intensely concerned with the need to understand the various and complex ways that power operates to dominate and shape consciousness" (p. 283) and beliefs. Ideological hegemony is a central concern of my research, as I believe our values and human-nature relationship are intricately tied to dominant corporatist discourses—discourses that may be 'finding' their way into our schools through curricular resources. Drawing upon Lemke (1995; 1998a), Kincheloe and McLaren suggest, "researchers operating with an awareness of this hegemonic ideology understand that dominant ideological practices and discourses shape our vision of reality. ... [and] the constructions people make of their world and their role in it" (p. 283). In this way, I recognise that language and discourses are not neutral—they do not "mirror society," but rather "serve to construct it" (p. 284). Within a critical theory perspective, Kincheloe and McLaren define discursive practices as, "a set of tacit rules that regulate what can and cannot be

said, who can speak with the blessings of authority and who must listen, whose social constructions are valid and whose are erroneous and unimportant" (p. 284). Consequently, ideological hegemony and power discourses act to undermine the manifold, potential meanings of language, constructing one correct interpretation that "implants a particular hegemonic/ideological message into the consciousness of the reader" (p. 284). My research seeks to expose the discourses and hegemonic messages at work in environmental/science curriculum resources.

Methodological Approach

There are many different research approaches possible within a critical theorist paradigm. As my inquiry is concerned with the language and visual images of textual resources, some form of textual analysis is necessary. However, my interest is in the dialogical meaning of a text and how a text acts to socially construct the identity and experience of the reader. As a consequence, the analytical method must attend to semantic content and rhetorical interaction in relation to language and other symbolic systems in a social context—in other words discourse (Lemke, 1995; 1998a). Discourse analysis embodies a theory of meaning making that co-exists alongside a sociocultural theory of human behaviour (Lemke, 1995). Unlike corpus analysis, which is quantitative and concerned with the pattern and number of occurrences or co-occurrences of particular keywords, discourse analysis is a "form of 'qualitative' social analysis" (Fairclough, 2003, p. 6).

Interpretation is central to all critical theory-based qualitative research (Kincheloe & McLaren, 2000); critical discourse analysis is no exception. Kincheloe and McLaren suggest critical qualitative research is inextricably linked with critical hermeneutics, "that

in qualitative research there is only interpretation" (p. 285). Further, Kincheloe and McLaren state,

> In its critical theory-driven context, the purpose of hermeneutical analysis is to develop a form of cultural criticism revealing power dynamics within social and cultural texts. Qualitative researchers familiar with critical hermeneutics build bridges between reader and text, text and its producer, historical context and present, and one particular social circumstance and another. (p. 286)

Hermeneutics primarily centres on interpretation and understanding developed from ideas and values within given social contexts (Keeves, 1998). Hermeneutics is a circular, recursive process of interpretation, engaged in a back and forth part-whole whole-part relational and contextual analysis (Kincheloe & McLaren). Smith (1991) describes hermeneutic interpretation as the "playing back and forth between the specific and the general, the micro and the macro" (p. 190). Critical discourse analysis and analysis of interview data are complex, hermeneutical (interpretive) processes involving understanding, evaluation or judgement, and explanation—understanding the meaning of the text (images, words, phrases, and longer pieces of text) and the intended meaning of the producer; evaluation or judgement of the truth of claims as well as their accordance with social or institutional relations; and an explanation of the text producers'/writers' perspectives and why the text is written as it is, that is, is there a social cause (Fairclough, 2003). Being cognizant of what is *not* said is also crucial to critical hermeneutics.

Though critical discourse analysis can draw upon diverse approaches for analysing text (Fairclough, 2003), I have chosen to base my critical analysis of the discourse of selected environmental resources on the work of Lemke (1990; 1995;

1998a). Lemke's ideas are similar to those of Fairclough (2003) and Gee (1999; 2006), other well-known discourse theorists; however, Lemke's stance is situated within the ecosocial theory I am using to guide my research. Additionally, Lemke's approach is responsive to "the task of a critical sociological discourse analysis" (Luke, 1995, p. 11), hermeneutically bridging the micro analytic analyses of text with the broader macro approaches concerned with socially constitutive discourses and power relations (Luke).

Drawing on the work of Halliday (1978; 1985), Lemke (1995; 1998a) suggests three interdependent dimensions of meaning making may be derived from text semantics: presentational, orientational and organizational. The presentational dimension sets forth the specific themes of the text, providing "explicit description of participants, processes, relations and circumstances" (Lemke, 1995). This thematic dimension presents a construal of 'how things are'. Within presentational meaning, "the function of language [is] for presenting states-of-affairs, for saying what is going on" (Lemke, 1998a, p. 1178-1179). The orientational, or attitudinal, dimension constructs an evaluative stance towards audience and other related discourses. This dimension encompasses value preferences and points to a social and political stance. A third dimension is the structure of specific texts within a discourse, together with the organization of information to give prominence to selected pieces, giving rise to recognizable genres characterizing communities.

Similarly, Kress and van Leeuwen (2006) draw upon the work of Halliday (1978; 1985) in order to describe and analyze the semantic or meaning potential of visual text. They describe the social semiotic resources of visual text in terms of the representational (presentational), interactive (orientational), and compositional (organizational). Including analysis of visual text is important because visual text is especially prominent in

educational materials produced for elementary children and, as Lemke (1998b) points out, "the medium of printed scientific text is first of all a visual one" (p. 95)—meaning is co-constructed between visual and linguistic text. Conversely, meaning may be constructed from conflicting or contradictory messages; in multimodal text, visual text may construct one set of meanings and written text another (Kress & van Leeuwen). But, as Kress and van Leeuwen further point out, "however great the differences between the verbal and visual grammar, they derive from similar concerns and orientations" (p. 173).

Drawn together, Lemke's (1995) semiotic resource systems for language and discourse and Kress and van Leeuwen's (2006) semiotic resources of visual text, form the framework for the critical discourse analysis of selected environmental science classroom resources.

Data Sources and Collection

Critical discourse analysis requires detailed text analysis and is more productively applied to smaller samples of text, rather than a large corpus (Fairclough, 2003). Random sampling plays no part in the selection of discourse samples; the researcher gathers together the discourse events for particular purposes and by stated criteria (Lemke, 1998a). Covariation (contrasting yet correlated, comparative examples) is the basis for sample selection (Lemke); however, changes in discourse features and associated context is not known until thematic patterns of interest are determined. Accordingly, I selected a reasonably large and diverse corpus of texts with which to begin my initial survey and analysis of instructional resources. As thematic patterns emerged, the data were reduced to provide the most valuable samples for my research purposes.

Data are derived from print documents and websites produced by three representative subcommunities in the field of environmental science education: government (for example, Alberta Environment; Alberta Sustainable Resource Development), industry and industry representatives (for example, Alberta-Pacific Forest Industries; the Canadian Centre for Energy Information), and selected educational/ environmental nongovernmental organizations (for example, Inside Education; Pembina Institute; SEEDS Foundation) in the province of Alberta. As my interest lies with elementary science education, I selected only current resources suitable for K to 6 students. A 'current resource' refers to those resources readily available in print or online on regularly updated websites, produced by operational organizations.

Following an initial survey of all currently available environmental science instructional resources developed specifically for the Alberta elementary curriculum, six documents were selected for detailed analysis of the visual and written text (see Appendix A for resource bibliography). The selected documents address electricity/energy and forest ecosystems education at the elementary education level. These particular areas were chosen for several reasons:

- electricity and trees and forests are topics of study in Grades 5 and 6 respectively of the Alberta Elementary Science Program of Studies (Alberta Learning, 1996);
- the trees and forest topic includes environmental/human impact learning objectives;
- the electricity topic incorporates concepts dealing with energy and energy production which, in view of climate change and resource extraction procedures, is of concern to the environmental community;

- forests and energy are two predominant topics represented in the resources produced by the various subcommunities; and,
- the province of Alberta is known for its significant economic dependence on the fossil-fuel and forestry industries and conservative politics. This last reason points to the particular political and social context of production for these instructional resources.

In addition to textual analysis, interviews with the producers and/or writers of environmental science instructional resources were conducted. The interviews provide important intertextual/heteroglossic data as well as information about resource producers in order to provide a "context of production" (Lemke, 1998a, p. 1178). The intent of the interviews is to address questions such as: What is the pedagogical and scientific expertise of environmental science instructional resource producers/writers? Why do they think the production of these materials is needed? What principles or ideas do they keep in mind when writing resources? Who sponsors the production of these classroom resources? What are the interests of the sponsors? What ecological discourses are they a part of? The interview questions (see Appendix B) were designed to help me establish the background of the resource producers/writers and to allow me to realize the interviewees' discourses and perspectives on my research sub questions. The interviews were semi-structured, allowing for dialogue to develop between participants and myself, "becom[ing] a joint reflection on a phenomenon ... a conversational relation between two people" (Weber, 1986, pp. 65-66). The interviews provided a deep and multi-layered exploration of the topic.

Participants were purposely selected based on their affiliation with various subcommunities involved in environmental/science resource production in the province

of Alberta. Selected participants currently play a role in the production/writing of environmental science instructional resources for the elementary school market. Representatives from both government and three nongovernmental organizations were interviewed. Two of the NGOs are connected primarily with the environmental community and the third represents the energy industry's concerns and perspectives.

I approached each of the participants by way of e-mail, sending them a letter requesting their participation in my research. An information letter describing the research and a consent form were included as attachments. All the participants' contact information was available online on the organizations' web sites, with one exception. In the latter case, I initially contacted the organization via telephone requesting e-mail contact information. At the outset, my request was denied, but upon further discussion and clarification of my proposed research, an interview date and time were scheduled. Seven participants were approached, six of whom agreed to participate in the study. The interviews, approximately an hour in length, were conducted in the offices of the participants. Interviews were digitally recorded and transcribed. Transcripts were returned to interviewees for validation of statements prior to analysis. Two of the six participants returned the interview transcripts with a few minor editorial changes. The other four participants did not return the interview transcripts.

Critical Discourse Analysis of the Documents: Methods

The selected texts from each environmental/science education subcommunity have been examined closely with special attention to the language patterns and visual text constructing a view of nature; the human-nature relationship; presentation of multiple perspectives; discursive management of uncertainty; and the dimensions of ecological

literacy, that is, functional, cultural and critical literacies. Particular attention is given to those sections (activities or lessons) in the texts that are concerned primarily with human uses of or perspectives about forests and forest ecosystems in the forest resources, and issues regarding energy consumption/production and renewable/non-renewable sources of energy in the electricity/energy resources. The text analysis draws upon the analytic methods employed by Veel (1998) and Kress and van Leeuwen (2006) within Lemke's (1995) semiotic framework. Östman's (1994, 1998) descriptors for view of nature and human-nature relationship are used to illustrate these particular dimensions. For each document, the discourse patterns within the texts have been drawn out.

To facilitate analysis, matrices were constructed for each document (see Appendix C for sample document matrix). The 3 x 5 matrices were structured around Lemke's (1995) three interdependent dimensions (semiotic metafunctions) of meaning-making: the presentational, orientational, and organizational; and the five concepts examined for this study: the view of nature, the human-nature relationship, the presentation of multiple perspectives, the discursive management of uncertainty, and the dimensions of ecological literacy. The written text was analysed alongside the visual, though each draws upon different methods for analysis. Analysis of the written text centres on the language and grammar of the text, specifically the patterns in relation to cause-and-effect links and human agency. These patterns are expressed through grammatical features such as nominalization, grammatical metaphor, modality, and possessive deixis. [See Appendix D for Glossary and Chapters 4 and 5 for examples of these grammatical features and how they contribute to the discourse analysis of the written text. For further explanation of these terms, see Halliday and Matthiessen (2004).]

The analysis is not a detailed linguistic analysis but rather draws upon selected linguistic and grammatical features that best illustrate the presentational, orientational and organizational dimensions of the text in relation to the five concepts. Additionally, what is omitted or not said is also considered as part of this critical approach to discourse analysis. An examination of what is said and *not* said is essential to understanding the companion meanings embedded in the text.

The visual texts in the instructional resources included in this study are predominantly illustrative drawings suitable for younger children. Some of the materials include posters (frequently referred to in the written text); others include illustrations interspersed within the written text for students. Some of the images are produced in colour; others are black and white images. Visual text also includes multimodal representations such as typographical features of written text (i.e. use of different fonts, bold, and italics, caption and figure space, etc.) and dynamic interactives of digital text (i.e. animated and/or interactive graphics, hypertext, etc.). Analysis of the visual text draws upon the methods used by Kress and van Leeuwen (2006) in *Reading images: The grammar of visual design.* These methods include examining features of visual text such as: narrative or conceptual representations (realized through processes, circumstances, structured or unstructured analytical processes, etc.); interactive meanings (realized through contact, social distance, and attitude); and composition (realized through information value, salience, and framing). [See Appendix D for Glossary and Chapters 4 and 5 for examples of these features and how they contribute to the discourse analysis of the visual text. For further explanation of these terms, see Kress and van Leeuwen (2006).]

Interpretive Analysis of the Interviews: Methods

Through a careful reading of the interview transcripts, I began to become aware of the views of the participants, reflective of the organizations' perspectives. Starting from my theoretical perspective and then working inductively through the interview data, I identified themes and subthemes. The a priori themes developed from the literature and my theoretical orientation, and are interrelated with the five concepts focused on for the document analysis (i.e. view of nature, human-nature relationship, uncertainty, multiple perspectives, and ecological literacy). I induced other themes and subthemes from an in-depth reading of each of the transcripts. Drawing upon the suggestions of Ryan and Bernard (2003), the techniques I used to identify themes included scrutinizing the text for instances of repetition of concepts and systematically comparing data, searching for similarities and differences. Additionally, I noted instances of 'missing data', essentially recognizing what is not said. Finally, as these were semi-structured interviews, the interview questions created topical transitions, thereby marking themes.

For purposes of managing and processing data, identified themes and subthemes were hierarchically organized and numerically coded; a code book was created to record this information (see Appendix E). Transcript data were then organized electronically in table form using Microsoft Word software (see Figure 1). In this way, data could be searched and sorted based on different analytic criteria using Word's Table/Sort function. For example, using the theme code as the primary sort key and the sequence number as the secondary sort key, data can be sorted by theme code, sequenced numerically within each coded theme (see Figure 2). This is essentially an electronic version of 'cutting and sorting' of data. The data tables for each participant were merged to allow for sorting and

systematic comparison of all participants' responses. [For further information on using Microsoft Word software to organize and code data, see La Pelle (2004).]

Participant Name	Org. ID	Theme Code	Interviewer Question / Participant Response	Sequence #
Interviewer	D	**2.00**	**but you've written resources?**	13.00
Brian*	D	2.40	Ah, yes, written, delivered, developed, evaluated ... the whole nine yards, yes.	14.00
Interviewer	D	**2.00**	**And so your role <u>now</u> in terms of resources and resource production?**	15.00
Brian	D	2.20	Some writing more sort of overseeing	16.00
Brian	D	6.40	... um I'm the seal for final approval for all of our resources.	16.01

Figure 1. Data table excerpt from interview with resource producer. (*pseudonym)

Following the identification, organization, and recording of themes and subthemes, themes were chosen for analysis based on their salience to the research questions. The identification and winnowing of themes is dependent on my judgement as a researcher. As Dey (1993) noted, "there is no single set of categories [themes] waiting to be discovered. There are as many ways of 'seeing' the data as one can invent" (pp. 110-11). It is therefore important that I make explicit the basis upon which these judgements are made. Additionally, I employed triangulation—the identified themes and subthemes, as well as sample analyses of interview data were given to an outside researcher experienced in qualitative interview data analysis as a check against my initial interpretation and analysis. Triangulation is useful to strengthen rigor and trustworthiness in qualitative research (Lietz, Langer & Furman, 2006).

Participant Name	Org. ID	Theme Code	Interviewer Question / Participant Response	Sequence #
Amy	A	6.20	and vetted by science experts, etc. *Right*	219.02
Interviewer	B	**6.20**	**How do you locate your different people, your experts?**	457.00
Gwen	B	6.20	So based on those relationships, they help us identify you know who the expert reviewers are and then we seek to invite them to participate and get them to confirm their participation in the whole process.	458.01
Elaine	C	6.30	Um but then we do have um reviewers // some of them are funding // our sponsors review as well	118.03

Figure 2. Excerpt from merged and sorted data table, sorted by theme code and sequence number.

Questions of Trustworthiness

> The central question embedded in validity [is]: How do we know when we have specific social inquiries that are faithful enough to some human construction that we may feel safe in acting on them, or, more important, that members of the community in which the research is conducted may act on them? (Lincoln & Guba, 2000, p. 180).

The question posed by Lincoln and Guba cannot be definitively answered, however there are useful bases upon which we make judgments. The authors describe validity or rather trustworthiness in qualitative research in terms of goodness or quality. The criteria for determining the goodness or quality of research grounded in critical theory centres on "historical situatedness, [the] erosion of ignorance and misapprehensions, [and] action stimulus" (Lincoln & Guba, 2000, p. 170). With this in

mind, the goodness or quality of my research will depend on how well I have contextually situated the discourse analysis; how well I have exposed hegemonic ideologies and power relations; and how well I have positioned my readers to, at the very least, recognise the need for change. I cannot make claims to truth; I can only try to reflexively engage in research that helps me, and hopefully others, better "understand the world and the way it is shaped in order for [us] to transform it" (Kincheloe & McLaren, 2000, p. 297).

Critical research, as a form of "self-conscious criticism," (Kincheloe & McLaren, 2000, p. 292) requires that I make explicit my role as researcher, my own biases and assumptions. By clarifying my personal biases and assumptions, the lens (perspective) I am looking through for interpretation can be made transparent. In turn, I can try to 'step back' and examine my interpretations from alternative perspectives. However, I recognise the difficulty inherent in this—I am an insider "*positioned* within [a social] system so as to have only one point of view on it, or only a limited range of viewpoints" (Lemke, 1995, p. 20). This does not mean that I am "trapped by [my] prejudices" but rather, as Smith (1993) suggests, I will "be open to risking and testing [my] prejudices in [my] dialogical encounters with others" (p. 196).

Critical research is undeniably political—I seek to not only increase knowledge but also to provide an impetus for change towards an ecologically literate world. As Kincheloe and McLaren (2000) so eloquently write,

> To engage in critical postmodern research is to take part in a process of critical world making, guided by the shadowed outline of a dream of a world less

conditioned by misery, suffering, and the politics of deceit. It is, in short, a pragmatics of hope in an age of cynical reason. (p. 303)

In the next three chapters, I turn to the critical discourse analysis of the instructional resources (Chapters 4 & 5) and the interpretive analysis of the interview data (Chapter 6). The analysis is conceptually framed within ecosocial and critical theoretical perspectives in order to explore the role of discourse in shaping ecological literacy, identity, and environmental consciousness.

CHAPTER 4: DOCUMENT ANALYSIS AND FINDINGS: LIVING SYSTEMS

My research includes a critical discourse analysis of six environmental science resources: three resources centre on forests and three on electricity and energy (see Appendix A for resource bibliography). As I began analysing the resources, I realised that comparing the forest and electricity/energy resources was somewhat like comparing apples and oranges. The forest resources are about living ecosystems; human-nature relationships play a central role. The topics of electricity and energy, though certainly encompassing environmental issues and concerns, are about nonliving entities and phenomena. The language of science—informational, explanatory—is dominant in these resources. Notions surrounding ecological literacy, multiple perspectives, and uncertainty are more conspicuous; human-nature relationships and the view of nature are deeply embedded within the language and images of the electricity/energy resources. Consequently, for reasons of clarity and continuity, I have chosen to separate the discussion of the document analysis into two major categories—living and nonliving systems. This chapter is about living systems, the forest resources. Chapter 5 addresses the analysis of the electricity/energy resources or nonliving systems.

Living Systems: Forest Instructional Resources

Three subcommunities in the field of science/environmental education produce the selected forest documents: a school district, the provincial government, and a nongovernmental organization. The three documents address forest education, primarily at the elementary education level. The school district resource, *Trees and Forests* was developed specifically for the Grade 6 science curriculum; Trees and Forests is a topic of study in the Grade 6 Alberta Elementary Science Program of Studies (Alberta Learning,

1996). The government resource, *Envirokids Investigate Forest Health*, explicitly addresses Grade 6 and 7 science curricular objectives. *Between the Stands*, the NGO resource, includes stated curricular connections to Grades 4 and 5 social studies, and Grade 6 science.

The NGO resource, *Between the Stands*, includes a teachers' guide, glossy colour poster, and accompanying student informational text in the form of a 'banner', suggestive of a news sheet. The government text is a student oriented activity booklet, presented as a narrative. It is somewhat reminiscent of a children's comic and puzzle book. With the exception of the front and back cover, it is produced in black and white. This resource, originally published in 2001, was recently updated (2006), and includes a teachers' guide published in 2004. The school district text is designed as a teacher resource for science instruction, complete with lesson plans and black-line masters of student worksheets (see Table 8 in Appendix F for living systems instructional resource overview).

The presentation of the findings in this chapter is organized into five major sections where the five themes central to my research will be examined in the selected resources: 1) view of nature; 2) human-nature relationship; 3) notion of uncertainty; 4) 'bias-balance' or presence of multiple perspectives; and 5) the dimensions of ecological literacy—functional, cultural, and critical.

View of Nature

As described previously (see Table 1, p. 24), Östman (1994; 1996; 1998) introduces four views of nature; classical, biomechanistic, ecomechanistic, and organicist.

Biomechanistic

According to Östman (1994), a biomechanical nature language "expresses the view that nature functions as a machine and its purpose is to create and maintain life" (p. 148). This particular view of nature fits well alongside the relationship of human beings as exploiters of nature. The focus in biomechanism is on the functional role of the parts—"components of a forest" are listed taxonomically (*Trees and Forests*); forest health can be "measured" (*Envirokids*). In the school district resource, the interaction and connectedness of a complex ecosystem, such as a forest, is glossed over or muddied. For example, the student worksheet[5] (Master #1) that accompanies the activity "The Forest Ecosystem" is an inclusive analytical structure (see Figure 3). As such, it does not

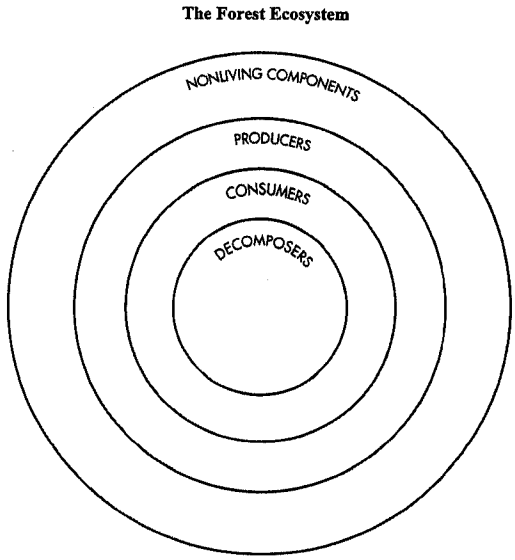

Figure 3. The forest ecosystem worksheet (e.g. inclusive analytical structure). (*Trees and Forests*, 1996, p. 91)

[5] The lesson plan suggests teachers use this black-line master as an overhead to "introduce the vocabulary: *producers, consumers,* and *decomposers*" (*Trees and Forests*, p. 5). Students, each with their own copy of this worksheet, are then directed to transfer the information from previously constructed T-charts on to this worksheet diagram. Students are to "list and classify the Living and Non-living components of the forest in a T-chart" (*Trees and Forests*, p. 5).

represent an interconnected or complex relationship. Rather, 'decomposers' are represented as attributes of 'consumers', which, in turn, are attributes of 'producers', and so on. The construction could be interpreted as hierarchical rather than interconnected. As Veel (1998) suggests,

> The division of the physical world into discrete objects and classes of objects promotes the 'nature as machine' view of the environment, encouraging us to view physical systems as discrete and mechanical, and discouraging us from thinking of them as interactive and complex. (p. 120)

In another example from this lesson, the "Teacher's Notes and Debriefing" describes a forest ecosystem in terms of simple cause-and-effect links and as a list of "components." The following text illustrates a chain of cause-and-effect links: "Trees shade the ground from the sun lowering air temperature which also reduces drying; so forests tend to be humid and the soil moist" (*Trees and Forests*, p. 6). The chain of events can be traced as follows:

trees shade the ground ⟶ lower air temp. ⟶ reduce drying ⟶ so forests humid

The accompanying student worksheet (Master #2) requires students to list the effects of various organisms on trees, in table format. The structure suggests simple cause-and-effect links rather than complex interactions and dependencies, portraying a biomechanistic view of nature.

Ecomechanistic

Östman (1994) describes an ecomechanistic view of nature as using more holistic language which suggests "that nature is a self-regulating whole. Everything influences everything else, and the function of the self-regulating whole is to generate and maintain

life" (p. 148). The NGO resource, *Between the Stands*, predominantly presents this view, both in the language of the text and the conceptual representations of a forest on the accompanying poster.[6] Analytically, the poster images depict the forest as a whole (carrier), made up of a number of connected or conjoined parts (possessive attributes) (Kress & van Leeuwen, 2006). The images portray, to some extent, a shared responsibility and relation to an interconnected whole, as does some of the accompanying text. However, other textual features remove human agency and connection.

From a narrative analysis, the inner poster image portrays a positive relationship between human beings and nature, at least from a human perspective. Where facial expressions can be determined, the humans are all smiling and happy as they impact essentially every area of the forest. The animals appear to co-exist peacefully alongside humans—they are presented in close proximity to humans and human-based industry and activities. But if we compare the wildlife depicted on the front of the poster (natural forest) with the wildlife in the human-used forest, changes as a possible consequence of human impact are evident. The numbers of individual animals are considerably less as is the biodiversity in terms of numbers of species (see Table 3).[7] However, teachers and students will have to come to an awareness of this difference without support from the accompanying lessons in the teachers' guide. There are two lessons in the guide that refer specifically to the depicted wildlife, "Wildlife What's My Line" and "Wrong-way Woodland Caribou,"

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[6] The Between the Stands poster is designed with fold-over panels depicting two views of the same forest. The outer two panels depict "the natural forest without any obvious use or changes by human beings." The inner panel shows the same forest, depicting "the various ways that humans make use of the forest and through this use, change it." (*Between the Stands: Student 'Banner': Introducing the Poster*, 1999)

[7] It is entirely possible that the designers of the poster did not consciously include fewer numbers and species of animals on the human-used forest image as representative of human impact. Rather, the lower numbers may merely reflect a space limitation—the human-used forest image includes more illustrative imagery such as industries, roads and other infrastructure, agriculture, etc., thus limiting the space available to represent wildlife.

but neither lesson mentions loss of biodiversity or a decline in animal populations as a consequence of human development and industrial activities. The implication is there, but what is *not* said may 'speak volumes', communicating a particular view of nature.

Table 3
Numbers of animals, species and humans represented on the *Between the Stands* poster

	Natural forest	Human-used forest
Animals		
Wild	62	31
Domestic	0	9
Species		
Wild	22[†]	13[††]
Domestic	0	3
Humans		
Visible	0	55
Implied[†††]	0	8

[†] Species include: bear–grizzly; birds–black-capped chickadee, duck, Canada goose, blue jay, ruffed grouse, heron, osprey, passerine (non-identifiable), pelican, pileated woodpecker; chipmunk; deer–mule, whitetail; dragonfly; elk; grey wolf; hare; moose; pine marten; swallowtail butterfly; red squirrel.
[††] Species include: bear–black; beaver; birds–duck, grey jay, osprey; woodland caribou ; coyote; deer–mule, whitetail; moose; porcupine; red fox; red squirrel.
[†††] Refers to humans implicitly present as machine operators, e.g. flying an airplane, driving a truck.

Organicist

For the most part, the text in the teachers' guide of the NGO resource, *Between the Stands*, constructs a view of nature that is ecomechanistic, whereas the poster images could be construed as shifting between an ecomechanistic and an organicist view. Östman (1998) suggests an organicist view recognises nature "as an organism, a life-giving entity, in which the parts are subordinated to and intelligible in relation to the whole" (p. 63).

Complexity or systems thinking is central to organicism. Similar to the poster images, the student text (banner) moves back and forth between the ecomechanistic and organicist. Forests and forest ecosystems are described functionally (ecomechanistically); the constituents are described in relation to their influence on other parts. Nevertheless, words such as "interaction," "community," "web" and "ecosystem" construe a more holistic and organicist view of nature. Consequently, depending on the particular piece of written or visual text examined, the view of nature subtly shifts.

The government resource, *Envirokids*, also presents a blended view of nature. The student text shifts between a biomechanistic view and ecomechanistic, depending on the activity analysed. The teachers' guide, which was produced two years after the first edition of the student resource,[8] contains additional text that construes a fairly strong ecomechanistic view of nature, counter to some of the biomechanistic views constructed in the associated student text. The activity "A Healthy Forest" exemplifies the differing views of nature. In the student text, there is an image of a young girl examining a branch from a tree (see Figure 4). The girl's expression suggests she is distressed by the damage caused by a caterpillar. A narrative analysis of this image reveals a bidirectional transactional structure, as evidenced by the strong vector from the caterpillar to the girl and the vector created by the girl's eyeline towards the caterpillar on the leaf (Kress &van Leeuwen, 2006). There is an interactive relationship between the two participants, the girl and the caterpillar. The caterpillar is the cause of the girl's distress. She, in turn, appears to question (note the question marks in the background) what it is she can do to alleviate the 'problem'. Her expression and dismay leave little doubt that it is a problem to be

[8] The student resource was revised in 2006 but very little was changed—contact information (i.e. URLs, telephone numbers, etc.), an error in one of the diagrams, and some minor wording in the *Alien Invaders* activity text.

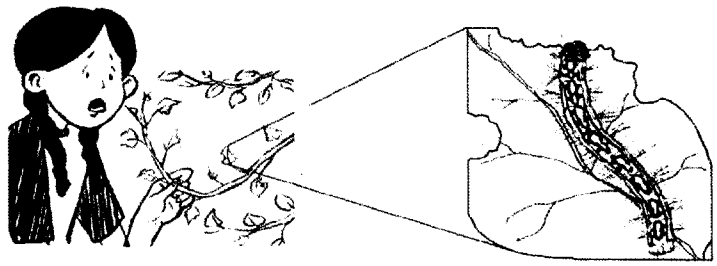

Figure 4. Image showing a negative, interactive relationship between the girl and the caterpillar/pest. (*Envirokids*, 2006, p. 16)

fixed, rather than an instance of an organism living its life relationally, as part of an ecosystem. The accompanying text supports the notion that organisms such as caterpillars are to be viewed predominantly as "pests" that damage trees, ostensibly reducing the forest's productivity, value and use for human consumption. Conversely, the text in the teachers' guide suggests an alternative perspective, one that recognises the intrinsic value and necessary place of all forest organisms.

> A healthy forest ecosystem needs a balance of organisms where each has a role to play—forest insects and disease help break down old, dead, and decaying material in the forest; they also provide food for other animals; they are part of the biodiversity of a forest. (*Envirokids: Teachers' guide*, p. 12)

However, taken as a whole (student and teacher texts), the predominant view of nature in the *Envirokids* instructional resource is ecomechanistic.

The three forest texts analysed construct a range of views of nature. The *Trees and Forests* resource is predominantly biomechanistic; there are glimpses of the ecomechanistic, but the language used often counters this view, shifting it towards the biomechanistic. The *Envirokids* resource communicates an interesting blend of

biomechanistic and ecomechanistic views of nature; the student resource, at times, constructs a biomechanistic view of nature, which is countered by ecomechanistic text in the teachers' guide. And the third resource, *Between the Stands*, principally communicates an ecomechanistic view of nature, with a few subtle shifts towards the organicist.

Human-Nature Relationship

Parallel to the findings regarding the discursive management of the view of nature, the three resources construct a range of human-nature relationships. The subject focus of these may be described as *Exploitation of Nature*, *Survival of Homo sapiens*, and *Preservation of Nature* (see Table 2, p. 25).

Exploitation of Nature

The *Trees and Forests* resource and, in some instances, the *Envirokids* student text, communicate similar visions of the relationship between human beings and nature—that of *Exploitation of Nature.* Östman (1994) describes this subject focus in terms of how "human beings have used or can use nature to promote their material welfare. ...[It] also implies that nature is a resource for exploitation by human beings and that we have no moral responsibility in that respect" (p. 145). The school district text, in particular, constructs a relationship whereby humans have the power and control to decide the uses of and, essentially, fate of forests and forest organisms. For example, human agency is expressed in terms of control (underlined text), evident in the following text: "You are <u>in charge of deciding</u> which different animals live in the forest. ... You are <u>in charge of creating</u> a forest which will improve the wildlife value" (*Trees and Forests*, p. 131). The

language connotes an almost God-like role for humans in the 'creation' of forests. Additionally, the 'value' of wildlife is viewed entirely from an anthropocentric position; wildlife has virtually no intrinsic value on its own. Though the students are told, "you are responsible for protecting the habitats of the animals in the forest and monitoring the numbers and health of their populations" (*Trees and Forests*, p. 131), the list of possible 'changes' or actions suggested for the students to consider are human-centric:

a. Harvesting of patches of trees so more plants will grow. Game such as deer like to live at the edges of openings so they can find food and cover.
b. Building a road system that will allow hunters and fishermen to spread evenly throughout the forest.
c. Deciding which areas will be allowed for hunting or fishing versus protected areas.
d. Include areas that will be used as food plots (eating areas for wildlife). (*Trees and Forests*, p. 131)

The relationship between humans and animals signified by the text is as a resource (i.e. game) for human use and exploitation. This particular lesson, "Managing the Forest," incorporates a series of student task cards whereby the students are to take on different management 'roles': wildlife; watershed; wilderness; recreation; industry; and fire, insect and disease managers. For each task, the students are to "plan one change to the forest" (note, not for) from a given list of "possible changes." With the exception of 'wilderness managers', the lists of 'possible changes' reflect benefits for humans and "impl[y] that nature is a resource for exploitation by human beings" (Östman, 1994, p. 145). No explicit statements or implicit indications of moral responsibility are included in the text.

Value is recognised in terms of monetary/economic value or usefulness. It should be noted that this text never purported to be an environmental science text; it is an information-oriented science resource, embodying the language of school science. Nevertheless, the language of the text acts to construct a particular relationship between human beings and nature.

Survival of Homo sapiens

The government-produced student text, *Envirokids*, though similar in some respects to the school district text, does not express human control or power nearly as strongly. There are also suggestions of an implicit moral responsibility towards nature, shifting the human-nature relationship towards *Survival of Homo sapiens*. Within this subject focus, it is hoped that students will develop an attitude of responsibility for nature. "Human beings are dependent on nature, which implies that the survival of Homo sapiens is dependent on the well-being of nature" (Östman, 1994, p. 146). This stance is considered human-centric or anthropocentric. Forests are still presented primarily as a resource for our own use. Possessive deixis is frequently used: "our forests," "our use," and "our world." In the student activity, "A Healthy Forest," the majority of reasons given for the importance of a healthy forest are to sustain its usefulness as a resource for human use, now and for future generations. The most salient feature on the two-page 'photo album' layout is the heading "What does a Healthy Forest mean to you?" The letters in the words 'Healthy Forest' are 'constructed' out of lumber (see Figure 5). This suggests a strong, underlying conception of forests *as* lumber and wood products, ostensibly for human use. (The use of the 'lumber' font is repeated throughout the resource.) The pages contain ten 'photos' (sketched drawings) of people representing

different viewpoints, that of forester, environmentalist, hunter, camper, biologist, government official, First Nations person, oil and gas worker, and so on. With the exception of the biologist, who suggests forests are important for plant and animal organisms, each person or represented participant constructs a view of forests in terms of 'our' (human) needs. The environmentalist's representation constructs a view that could be interpreted from a human or biocentric view, depending on whether or not the phrase "for future generations" refers to human beings or the more-than-human. She says (addressed to the reader, i.e. child),

> For me, a healthy forest can live forever without any intervention from humans. The streams are clean for fish and the rain is pure for roots. The activities that take place in the forest should help, not harm the forest for future generations. (*Envirokids*, p. 14)

Figure 5. The 'lumber' font used to construct the words 'Healthy Forest' in the heading, What does a Healthy Forest mean to you? (*Envirokids*, 2006, p. 14)

Overall, the resource communicates a relationship between human beings and nature that is a blend of *Exploitation of Nature*, whereby "human beings have used or can use nature to promote their material welfare" (Östman, 1994, p. 145) and *Survival of Homo sapiens*, whereby human beings depend upon nature for our continued existence.

Preservation of Nature

Similar to the *Envirokids* resource, the subject focus of the instructional resource produced by the NGO, *Between the Stands*, shifts depending on the intent of the particular piece of text. For example, in the section of the banner (student textual resource) titled "Value of the Natural Forest," the subject focus shifts from a *Survival of Homo sapiens* human-nature relationship towards *Preservation of Nature*. This focus is very similar to *Survival of Homo sapiens*; both include a responsible attitude towards nature as a learning objective. The difference rests on the reasons why humans should be respective of and responsible for nature. In *Preservation of Nature*, nature is viewed as having "intrinsic values which human beings do not have the right to violate. ... It is biocentric, or nature-centred" (Östman, p. 146). In this piece of text, a biocentric perspective regarding the importance of a forest ecosystem is implied though not explicitly stated. Forests are described as "very important" to biodiversity, the "environment as a whole," and to the "whole world." This is preceded with the value of a forest described in terms of its importance to "our national economy" and for personal recreation and enjoyment. Consequently, there exist subtle shifts in subject focus within this piece of text. However, if we take a step back, so to speak, and visually examine this particular page of the banner, the piece "Value of the Natural Forest" is positioned in the lower, left-hand corner of the page, a position low in salience and less highly valued (Veel, 1998; Kress & van Leeuwen, 2006). If we look from even further back, at the typography of the banner as a whole, the headings that strongly stand out are information focused—"The 'Rules' of the Forest," "What is a Forest?" and "Forest Quick Facts." Orientationally, font types, sizes, and boldface can indicate emphasis or importance.

Organizationally, the placement, sectioning, and spatial relations (i.e. caption space to figure space) indicate preferential reading order, suggesting "what goes with what" (Lemke, 1998b, p. 95). The banner typography and organizational structure places emphasis on the factual or informational texts.

The poster that forms part of this resource also orients the reader/viewer towards a particular relationship with nature. For example, in representations of humans or animals (quasi-humans) where eyes are distinguishable, the type of gaze, direct or indirect, construes a particular orientation to the represented participants. According to Kress and van Leeuwen (2006), a direct gaze "demands that the viewer enter into some kind of imaginary relation with him or her" (p. 118). The type of relation is signified through some other means, usually facial expression. The only represented participant (human or animal) on the poster that gazes directly at the viewer is the pine marten (lower, right-hand corner of the 'natural forest' poster). The marten's expression could be interpreted as angry or perhaps hostile (i.e. downward, drawn-in eyebrows; open mouth with bared canines). Accordingly, the marten's expression asks the viewer to relate to wildlife in a wary or cautious way, perhaps to be frightened of wildlife. Its prominence in the depiction of the natural forest may also suggest the viewer 'back away'; that the natural forest is not to be entered. The oblique angle of the pine marten's body indicates detachment (Kress & van Leeuwen). However, the marten's head is turned, gazing directly and demandingly at the viewer. This suggests a double message, perhaps "'although I am not of your world, I nevertheless make contact with you, from my own, different world'" (p. 138). The relationship construed between humans and nature is that of separation and difference. Our connection with nature becomes tenuous and distant.

This notion of disconnection is reiterated in the other depictions of animals and humans on the poster. Other than the marten, all others address the viewer indirectly. Kress and van Leeuwen call this type of indirect gaze an 'offer'—"it 'offers' the represented participants to the viewer as items of information, objects of contemplation, impersonally, as though they were specimens in a display case" (p. 119). Again, our interconnection with the natural world is diminished and, to a certain degree, mechanized. Though the messages/companion meanings are mixed, taken as a whole the resource construes a relationship with forests, and subsequently nature, that recognises some responsibility for nature but is human-centric.

In a manner similar to view of nature, the three forest texts construct different and shifting relationships between human beings and nature. The *Trees and Forests* resource predominantly constructs an *Exploitation of Nature* relationship, which is consistent with the resource's biomechanistic view of nature. The *Envirokids* resource communicates a shifting perspective, between *Exploitation of Nature* and *Survival of Homo sapiens.* And the third resource, *Between the Stands*, principally communicates a human-nature relationship of *Survival of Homo sapiens* with a few instances of shifts towards *Preservation of Nature* depending on the piece of text analysed. These findings are not unexpected given the resource producers' intended audience and goals. The school district text, *Trees and Forests*, was produced as a science instructional resource; the government text, *Envirokids*, is produced by the province's environment department in partnership with sustainable resources, which is the province's forestry department; and, the NGO text, *Between the Stands*, is produced by an NGO with ties to the environmental education community.

Notion of Uncertainty

By their very definition, issues are topics for debate; questions of concern that are often controversial and uncertain. The notion of uncertainty is no less relevant to science, and may be appreciated as a feature of 'science-in-the-making' (Bingle & Gaskell, 1994). The inclusion of controversial ecosocial/scientific issues, rooted as they are in science-in-the-making, raises concerns about how the notion of uncertainty and tentativeness should be managed in resources for schools. Consequently, environmental issues concerning forest use and development practices can challenge the expectations of certainty and presentation of 'facts' in traditional school science.

Both visual and written texts employ grammatical features to indicate the degree of certainty or doubt. Drawing on Halliday (1985), Kress and van Leeuwen (2006) refer to these grammatical features as modality, and explain the relationship to linguistics:

> The term 'modality' comes from linguistics and refers to the truth value or credibility of (linguistically realized) statements about the world. The grammar of modality focuses on such modality markers as the auxiliary verbs which accord specific degrees of modality to statements, verbs like *may*, *will* and *must* (cf. the difference between *He may come* and *He will come*) and their related adjectives e.g. *possible*, *probable*, *certain*) and adverbs. (p. 155)

Visual modality markers are scaled and include: colour saturation (i.e. full, rich colour to black and white); colour differentiation (i.e. full range or variety of colours to monochrome); colour modulation (i.e. tone, for example, several shades of green); contextualization (i.e. nonexistent background to fully detailed); representation (i.e. abstract to detailed images); depth (i.e. perspective); illumination; and brightness. Visual

modality is usually judged on the basis of its accordance with photorealism. However, there are different standards for what is 'real' depending on orientation. In the science community for example, detailed, technical drawings, done in black and white and without perspective usually have higher modality than photographs. Thus, modality is orientational. Modality does not suggest absolute truths or certainties. Rather, it discursively constructs shared truths among social groups (Kress and van Leeuwen, 2006).

The notion of uncertainty is not strongly evident in the forest resources. Much of the information in the resources is simply presented as fact, especially in the school district text. Linguistic modality markers such as *might*, *perhaps*, and *sometimes* occur infrequently. For example, a simple word occurrence analysis of the *Envirokids* resource (student and teacher texts) illustrates the notion of uncertainty. Modality markers that indicate certainty (i.e. *will*, *is*) significantly outnumber modal words that suggest uncertainty (i.e. *may*, *might*, *could*, *probably*, *possible*), especially in the student text (see Table 4). I am not sure why the language of the student text expresses a stronger degree of certainty. Perhaps it is because we (adults, educators) seem to prefer (or, at the very least, are accepting of) 'telling' or 'informing' children of the 'facts', that is 'what is' or presenting a view of 'how things are'.

Interestingly, the three resources address issues around forest use and development practices in, what I would describe as a 'hands-off' manner. Possible issues are indicated (i.e. visually in *Between the Stands* and *Envirokids*, and as a list of topics in *Trees and Forests*), but the texts do not discuss or provide background information on controversial issues where there is uncertainty about possible outcomes, such as clear-cut

logging, logging in old-growth forests, oil production in sensitive areas, and so on. Rather, the student activities in the three resources suggest students research an issue or issues from different points of view, present their findings in some way, and, more or less, leave it at that. Consequently, the discursive management of uncertainty surrounding controversial environmental issues concerning forest use and development practices is essentially divorced from the instructional resources and left in the hands of the teacher and students.

Table 4
Word occurrence count of modality markers in *Envirokids* texts

Modal word	**Student text**	**Teacher text**
Certainty		
will	32	16
is	81	44
Total	**113**	**60**
Uncertainty		
could	5	4
possible(y)	0	2
probable(y)	1	2
may	12	14
might	0	2
Total	**18**	**24**

Multiple Perspectives/'Bias-Balance'

The Grade 6 Trees and Forests science topic includes the following specific learning expectation: "students will: identify an issue regarding forest use, identify the different perspectives on that issue, and identify actions that might be taken" (Alberta Learning, 1996, p. B.34). As a consequence, each of the forest resources includes student activities intended to address this outcome, at least in part.

Trees and Forests. The school district resource, *Trees and Forests,* addresses multiple perspectives and the notion of 'bias' in the lesson, "Issues, Issues, Issues." This lesson asks students to research an issue framed as a 'should' question. Examples given include: "Should we destroy forests to create ski hills in Jasper?"; "Should more camping sites and trails be created in our National Parks? Provincial Parks?"; and, "Should the forest be cleared to allow companies to make money from the selling of logs?" (*Trees and Forests*, p. 82). A list of possible issues or topics is provided in the "Teacher Notes and Debriefing." The teacher is cautioned to "be careful not to present *bias* [italics added] in this lesson, but rather, to ensure that students examine the issue from all sides, and form their own perspectives" (p. 82).

Envirokids. The *Envirokids* resource does not address multiple perspectives from an issues-based stance. Instead, different perspectives are presented regarding what constitutes a healthy forest (see *Human-Nature Relationships* section for a discussion of the activity "A Healthy Forest") and about different "users of Alberta's forests." In the second example, students are asked to examine the provided illustration and list the different users (see Figure 6). This image is an exhaustive analytical structure in which all possessive attributes of the carrier (forest) are theoretically represented. As Kress & van Leeuwen, (2006) state, "the world is treated as *though* it is exhaustively represented, as though the Carriers have these major components and no others" (p. 95). With the exception of the logging truck, this image does not include representations of forestry practices such as clear cutting, and includes only minimal industrial impacts. The image of the oil well and pump jack is barely noticeable (bordering the top edge, tucked up behind the gas station). The animals are positioned in the foreground giving these images

prominence. They also appear content (notice the elk's 'happy' expression) and undisturbed by human activity. Human presence is minimized—the images are smaller, placed in the background and/or partially hidden behind other objects, and drawn to appear fairly natural, particularly the road. Consequently, the different 'users' of the forest are incompletely and, to some extent, deceptively represented.

Figure 6. Illustration of the different "users of Alberta's forests." (*Envirokids*, 2006, p. 11)

Between the Stands. The NGO that produced the *Between the Stands* forest resource emphasises that their resources are 'bias-balanced' and present multiple perspectives. This resource does include stronger representation of the many different users of a forest (including animals), particularly on the inner poster image. Both industrial and recreational human activities are illustrated on the poster. Represented industries include: forestry—logging (including clear-cutting), sawmilling, pulp production, forest fire suppression, and replanting; trucking; oil/natural gas drilling; oil sands development;

agriculture—cattle ranching and crop farming; and commercial fishing. Recreational activities include: hiking and camping, fishing, canoeing, bird watching, skiing, golfing, horseback riding, and hunting. "Forest Fingerprints" and "'You Make the Call'—Find the Issues" are two activities in the teachers' guide intended to help students learn about the different users of a forest and the issues involved. However, as previously discussed in the preceding section (*Notion of Uncertainty*), these activities do not directly discuss or provide background information on controversial forest use and development practices issues.

The accompanying student text (banner) also addresses different perspectives. For example, perspectives concerning forest fires are presented in "Fire Is Not Necessarily a Four-Letter Word." Other perspectives are discussed in "Value of the Natural Forest"—viewpoints concerning economic or intrinsic values. Readers (presumably students) are asked to "think of all the ways the forest is important to you" from different perspectives, including from both a human and more-than-human stance. For example, "How do you think you would value the forest if you were a caribou? A caterpillar? A spruce tree? A wildlife photographer? A hunter?" Issues and opinions regarding the different uses and management of a forest are addressed in "The 'Rules' of the Forest." The presentation of the different perspectives in this section is interesting. The text begins with imagery, describing an idyllic encounter with "the pristine wilderness" and recreational activities that "bring to mind exciting summer or winter vacations in the wilderness—thick forests, beautiful creeks, shiny lakes." Readers are asked to imagine themselves hiking through a forest, "'zig[ging]' when [they] should have 'zagged'," and suddenly coming across a "big feller-buncher." The questions posed to students centre on safety rather than on their

impressions or concerns regarding logging practices. The text reads: "Is it safe for you there? Would you be happy to see this machine there when you thought you would be safe? Is it a good idea to have hikers and big machines so close together?" These are closed questions, requiring only yes or no answers; therefore there is no room for student interpretation. The text continues with a discussion of forest management (the 'rules' of the forest) and includes the following statements: "Canada makes a lot of products from the trees in the forest. ...That means that trees are cut down. What that also means is people have jobs"; and,

> Because nearly everybody realizes that forest companies and other industries such as oil and gas and mining aren't going to go away and that campers, hikers, and bird-watchers aren't either, our forests need to be *managed* to ensure that everybody can be safe and reasonably happy.

Students are then asked to consider "What kind of *compromises* might we have to make to come up with a *management plan*?" This section is intended to address different perspectives and uses of a forest; the stance, however, is from a *management* perspective. And while I agree that people must act and think critically and responsibly in relation to the natural environment, the language of management connotes a particular perspective. And I cannot help but wonder who makes the "rules of the forest"? Who decides who gets to be "reasonably happy"? How are these decisions made and in whose interests? Are different perspectives really presented?

Ecological Literacy Dimensions

Stables (1998) describes ecological literacy in terms of three dimensions—functional, cultural, and critical. Functional literacy requires a basic scientific

understanding of foundational concepts related to ecology—land-water systems, ecosystems, and populations and communities. Cultural literacy centres on values and a sense of connection and place—a consciousness of the natural world within which we dwell. Important to understanding cultural ecological literacy is an awareness of the dominant value systems. And finally, critical literacy equates to action—action dependent on an understanding of ecological concepts and the dominant value systems and power structures at play. School science deals primarily with functional ecological literacy, often neglecting the cultural and critical dimensions. Without all three dimensions, ecological literacy cannot be fully achieved. I draw on Stables' tripartite model to explore the various notions surrounding the dimensions of ecological literacy that became manifest through the language and images of the instructional resources.

As is perhaps to be expected, the three resources focus primarily on functional ecological literacy, providing foundational information about trees, forest components, insect pests, and so on. A few instances of cultural literacy are revealed in the resources, particularly concerning traditional patterns of interaction with forested ecosystems. And finally, critical ecological literacy is also present in the resources, especially as this objective, the need for decision-making and action regarding forest issues, is directly addressed in the elementary science curriculum; students are to "identify an issue regarding forest use ... and identify actions that might be taken" (Alberta Learning, 1996, p. B.34). Data samples for each resource are provided below.

Trees and Forests. The school district text, specifically intended as a science instructional resource, includes twenty-eight suggested student activities or lessons. Of the twenty-eight lessons, only five are not centred on foundational information. The activity,

"Human Use of the Forest – Past, Present, and Future," includes cultural and historical perspectives regarding the patterns of human interaction and relationship with forests. Critical literacy is addressed in four activities: "Managing the Forest," and "Issues, Issues, Issues," which involve critical thinking and decision-making; and "Enhance or Threaten?" and "Take Action!," which include action components. However, these last two activities seem to centre more on writing tasks rather than on the actual importance of taking action. For example, the activity "Enhance or Threaten?" asks students to "list all of the human actions that either enhance or threaten the forest" (p. 72). From this list, students are to choose one action, write a persuasive paragraph stating their opinion on whether they consider the "chosen action enhances or threatens the existence of the forest" (p. 72), and support their opinion. It is then suggested that "a poster could be drawn to advertise main points to encourage the enhancement or to discourage the threatening behaviour" (p. 72). The "Take Action"! activity directs students to "write a formal letter" using "a business letter format" to a person or agency to "express their concerns" (p. 83) (presumably concerns generated from the preceding activity "Issues, Issues, Issues," though this is not clearly stated). Their letters are to include the following:

a. reason for writing
b. the issue
c. why it is an issue
d. what the student sees as a plausible solution
e. request a response to the letter from the company (p. 83)

Additional procedural steps include editing, producing final copies, addressing the envelopes appropriately and then mailing the letters. Interestingly, in the "Teacher's Notes and Debriefing," the teacher is cautioned to remind the students to write "in a positive manner (not critical) so constructive action will occur" and "to balance bias" (p. 83), in other words, *not* to take a stand.

Envirokids. The *Envirokids* resources, both student and teacher, primarily attend to functional literacy and include few references that could be interpreted as cultural or critical ecological literacy. Cultural literacy examples include references to "Alberta's natural forested regions" and "Canadian tree products," which could be construed as having cultural implications. The teachers' guide suggests two activities for students which include action components: one, concerns "things [Albertan's] can do to help prevent accidental human-caused wildfires" (p. 10), and the other, suggests students create "an awareness advertisement ... to help prevent exotic species from affecting Alberta's forest ecosystems" (p. 15). The student resource makes reference to both forest fire and exotic species prevention, as well as suggests to students "when you reuse a forest product, you are helping to preserve one of Alberta's natural resources" (p. 12). These action references are framed in a perfunctory and casual manner.

Between the Stands. The *Between the Stands* forest resource more thoroughly incorporates cultural and critical ecological literacy dimensions, especially compared to the school district and government resources. Similar to the other resources, functional literacy is a primary focus, but this resource includes a few more references that could be construed as cultural or historical, such as "Alberta's provincial tree"; "Canada's national

symbol, the maple leaf"; "modern and traditional remedies for ... common health problems"; and,

> For a long, long time, 25,000 years in fact, people have hunted caribou. People have enjoyed eating their tasty meat, and using their warm fur to make clothes. They have also enjoyed recording stories of hunts by painting them on the walls of their caves.

This resource also includes suggestions and opportunities for students to think critically about forest issues and responsible behaviours and actions. For example, the student text (banner) includes two sections, "Practicing the Three Rs Reduces the Number of Trees Harvested" and "From Forest to Home," which pose questions for students to consider regarding the types of forest products humans use, whether we need these products, and what actions we can take to reduce product demand. The teachers' guide activity, "Forest Fingerprints" (p. 13-14), asks students to list the different human activities represented on the inner poster and to decide "whether the development was done to meet a human WANT or a human NEED." Students are then asked to assess whether the development is necessary, whether there might be "alternatives to the development," and to "discuss and decide whether there might have been other actions that could have been taken instead to reduce the impacts on the forests." The discussion section suggests questions for the teacher to "assist you and your students in understanding the role we, as individuals, play in forest development. It is important for people to develop an understanding that development is not really a 'They are doing ...' issue. We are all responsible." This implies critical thought and personal action. This statement also acts to subtly align teachers and students with a forest management and development perspective.

The analysis in this chapter centred on three instructional resources intended to address curricular objectives for the "Trees and Forest" Grade 6 science topic. Concerned with living ecosystems, it is plausible to conceive of a relationship between forests (nature) and human beings. The topic lends itself to an awareness and development of environmental concepts. However, any topic of study that centres on phenomena in the natural world, can also construct a particular human-nature relationship and view of nature and a consequent ecological discourse and perspective. In the next chapter, I turn to an analysis of instructional resources on the subjects of electricity and energy; nonliving phenomena and systems in the natural world.

CHAPTER 5: DOCUMENT ANALYSIS AND FINDINGS: NONLIVING SYSTEMS

This chapter addresses the analysis of the electricity/energy resources or nonliving systems. The presentation of the findings in this chapter is organized along the same lines as the previous chapter—into five major sections where the five themes central to my research will be discussed: 1) view of nature; 2) human-nature relationship; 3) notion of uncertainty; 4) 'bias-balance' or presence of multiple perspectives; and 5) the dimensions of ecological literacy—functional, cultural, and critical.

Nonliving Systems: Electricity/Energy Instructional Resources

Three nongovernmental organizations produced the electricity/energy documents included in this analysis. Two of the NGOs are connected primarily with the environmental education community and the third represents the energy industry's concerns and perspectives. Two of the resources (*Science 5* and *Electricity*) centre on the topic of electricity, incorporating information on energy and energy production and consumption. *Science 5* was developed specifically for the Alberta Grade 5 science topics of "Electricity and Magnetism" and "Mechanisms Using Electricity" (Alberta Learning, 1996). The second, *Electricity*, explicitly addresses Alberta elementary Grade 4 social studies and Grade 5 science curricular objectives, as well as Grade 8 (social studies), and Grades 7 and 9 (science) curricular objectives. The third resource, *Energy Literacy Series*, focuses on ten different sources of energy, and includes information on production, equipment, and issues. This resource was developed primarily for the Canadian secondary education system, but also incorporates stated Grade 6 curricular links for most of the provinces and territories. In Alberta, the science topic most closely associated with energy is located in the Grade 5 curriculum and as such, is not included in

the curricular objectives associated with this resource. However, this resource could potentially be used by Grade 5 teachers, either in preparing their instructional plans for the electricity topics or as a student resource.

The *Electricity* resource is organized as an instructional package containing a teachers' guide, glossy colour poster (4 copies), and a resource CD. The resource CD includes supplementary materials such as PDF files of student worksheets and copies of the poster, as well as supplementary information on the Science of Electricity, Electricity in Canada and Alberta, Electrical Safety, Energy Efficiency, and Energy Sources (petroleum, nuclear, renewable, and hydro). The supplementary information is provided by various corporations and informational organizations, such as the Coal Association of Canada, Canadian Hydro, Enmax, Natural Resources Canada, and the Centre for Energy. My analysis of the *Electricity* resource focuses on the teachers' guide, student worksheets, and colour poster, as these are the central pieces of the instructional kit; the classroom lessons are built around these pieces, especially the poster.

Both the *Science 5* and *Energy Literacy Series* resources are online documents. *Science 5* is organized as a series of five unit plans and includes teacher materials (curricular connections documents, background information and lesson plans), student activity pages and accompanying worksheets, a glossary, and section quizzes and answer sheets. Incorporated in each of the five sections are animated interactives, one per section. Interactives are graphical programs that allow students to 'interact' in some way with the image, such as clicking on hypertext or embedded links that lead to animated movements or changes. Additional text may appear or the animation may respond to changes in variables, and so on. For example, in the "Build a House" activity, students

can select appliances to add to the house, choosing old or new and which ones to turn on. This action simultaneously calculates an estimated utility bill, and indicates the level of energy consumed on the "Watt o'Meter." My analysis centres on the teacher and student materials, including the interactives.

The *Energy Literacy Series* is organized as a sequence of ten interactive modules intended for student use. Each of the modules (presented in a pictorial form similar to a television or DVD screen) provides hypertext links to each of the information sections: overview, virtual tour, production, equipment, and issues, impacts and outcomes. A table of contents is provided for each section—in the form of interactive buttons or hypertext—which leads to an information screen, or in some cases, an interactive map or animated video. The content headings vary depending on the module and section. The text-based information screens include bolded words which are hypertext links to pop-up windows. These may be text-based information windows that provide further explanation or information, pictures, or animated graphics. My analysis includes an examination of eight of the ten modules; tidal and nuclear energy are excluded as these sources of energy are not produced in Alberta. Modules included for analysis are: petroleum, coal, wind, hydro, solar, biomass, geothermal and Earth energy, and portable manufactured devices (see Table 9 in Appendix F for nonliving systems instructional resource overview).

View of Nature

The subject matter of electricity and energy tends to focus primarily on details and 'facts'; the minutiae of the features and functions involved in the physical processes. The how's and why's and what's of circuits, magnetism, generators, open-pit mining, combustion, electrons and atoms, to name but a few examples, are the primary

instructional foci. The language is predominantly scientific or technical, but as Östman (1994) suggests, the language of science serves to construct a particular view of nature. Through a careful examination of the language and images of the text, it is possible to appreciate the subtle view of nature constructed by the resources.

Biomechanistic

Of the three resources, The *Energy Literacy Series* is most suggestive of a human-centric, biomechanistic view of nature. This informational, principally text-based resource employs many of the grammatical characteristics of scientific textbooks, such as grammatical metaphor and middle and passive voice clauses. As Veel (1998) states, "the language of science plays an active role in embodying, or realising, the 'external' or 'object-oriented' ways of viewing nature inherent in the traditional Cartesian-Newtonian paradigm" (p. 115). The language of this resource largely construes nature as an object—a resource, external to humans and human agency, as illustrated below.

The many pages of text included in each of the modules frequently omit human involvement or participation, often through the use of middle and passive voice clauses (non-agentive clauses). The extraction, production, and processing of the various forms of energy are events that *just happen.* The following piece of text is a typical example of the use of a non-agentive pattern of language. Table 5 displays an analysis of these patterns.

> Obtaining crude oil and natural gas from deep underground reservoirs requires exploration, drilling, and then transport. Oil sands near the surface are mined in open-pit mines. In deep deposits, oil sands are drilled and the bitumen is separated from the sand, liquefied, and pumped to the surface. (Petroleum Energy module)

The text omits that it is humans who carry out these tasks—drill for oil, mine the oil sands. Energy extraction and production is presented as a process remote from human or other agentive causes. Consequently, the natural environment is construed as separate from human existence. The analysis (Table 5) illustrates how this excerpt centres on non-agentive clauses; one event leads to another with agency (human or otherwise) noticeably absent.

Table 5
Middle and passive voice clause (non-agentive) patterns in 'Petroleum' text

Process	**Medium**	**Agent**	**Circumstance**
obtaining	crude oil and natural gas		from deep underground reservoirs
requires	exploration, drilling, and then transport		
are mined	oil sands		near the surface in open-pit mines
are drilled	oil sands		in deep deposits
is separated liquefied and pumped	and the bitumen		from the sand to the surface

The implied absence of human involvement in the processes of energy production is also evident in the photographs incorporated in several of the text screens and pop-up windows. Of the 221 photographs used[9], 31 include humans[10], 2 of which were children. All but a very few of these are impersonal, long-distance shots. None of the photos are close shots. Social distance in images creates a relationship between the people (participants) represented in the image and the viewer, albeit an imaginary relationship

[9] The image count does not include the tidal or nuclear energy modules. Only photographic images were counted; graphics, maps and animations or videos were not included.
[10] Images considered as including humans include images with human hands. Images of hands were counted as impersonal representations of identity, as personal contact through facial images is absent.

(Kress & van Leeuwen, 2006). Long-distance images create a barrier between the participant and the viewer, suggesting the participants are objects for contemplation; there exists a 'disconnect' or lack of involvement. This may also engender a parallel disconnect between the activities represented in the images—the processes of energy production. The view of nature construed through an impersonal, disconnected orientation or stance is biomechanistic—the natural environment exists for human use.

A few of the modules analysed include language that constructs a more holistic or interconnected view of nature, for example, Solar Energy and, to a lesser extent, Hydro Energy. The following text excerpt from the Solar Energy module suggests interrelationships among Earth's living and nonliving systems. The text uses active voice clauses (underlined text), indicating participation and agency by humans (*we*) and the more-than-human (*green plants*).

> The energy of sunlight is absorbed by Earth's surface, warming the land, the water, and the air. *Green plants* use solar energy for photosynthesis, producing food that supports all forms of life except for certain types of bacteria. The solar energy industry develops technologies that capture and convert sunlight into energy *we* can use, such as heat and electricity. (Solar Energy module)

Note also that '*the* Earth' is not used—a language construction that implies a distance or disconnect, a 'hands-off' sensibility. However, agentive and connective language is the exception rather than the norm within this instructional resource. As a consequence, this resource presents a fairly strong biomechanistic view of nature.

The *Electricity* resource is similar to the *Energy Literacy Series* in that it too predominantly constructs a view of nature that is biomechanistic. However, there exists a stronger sense of the ecomechanistic in this resource.

The poster[11] included with the instructional package *Electricity* is the focal point for this resource. The teachers' guide comprises eight separate lessons or student activity suggestions; two of the eight do not incorporate the poster, in one the poster is optional, and in the remaining five, the poster is a key feature of the lesson or activity. Both the front and inner poster panels are very busy, intricate image collages.

The front of the poster focuses on the different sources of energy, featuring nine white circles enclosing photographs representing the various forms of energy production. For example, a coal power station, wind turbines, and a hydroelectric dam are pictured. These are the only photographic images on the poster—the other images are drawings. As a consequence, these images are the most salient feature of the poster front. These photographs of built structures appear in isolation; essentially disconnected from the surrounding environment and context. This 'disconnect' serves to present a view of nature that is biomechanistic—focused on the parts separate from the whole. Though more contextually represented, the other drawn images are also separated into constituent parts. The drawings allude to a broad spectrum of themes pertaining to electricity and energy. For example, industry, agriculture, forestry, cities, recreation, and travel and their potential electricity/energy needs are represented. The images or attributes are separated

[11] The *Electricity* poster, similar to the *Between the Stands* poster, is a three-fold design. The outer front panels "provides a look at the most common sources of electricity in Canada." The inner image "shows the integration of electricity into society with the STSE connections" and also incorporates "diagrams depicting a closer look at the sources of electricity." The poster back depicts "a step-by-step schematic of the generation, transmission and distribution of electricity." Also included are a textual explanation of electricity, 'The Electricity Story', and a cut-away diagram of a house "with individuals making "bright" and "not-so-bright" energy and electricity decisions." (*Electricity: Teachers' Guide*, 2005, p. ii)

by a road which acts to frame each section. Power lines run across each section, suggesting a mechanistic link to/dependence on electricity and energy.

Some of these background images represent nature and a possible connection between human beings and nature. For example, a natural wilderness area is depicted on the upper right quadrant of the poster front; we know this is a wilderness area because a 'sign' tells us so. But even this natural wilderness area is not left untouched—the area is bordered by a road and bisected by power transmission lines. However, the cartoon-like drawings of a bear and a deer (representative of wildlife) appear content with this situation—they are smiling. Whatever else this image might imply, it does suggest a more interconnected view of nature, moving towards the ecomechanistic.

Images on the inner poster primarily serve to construct a biomechanistic view of nature. The inner poster's most salient features are cut-away diagrams framed in white circles. The diagrams show the functioning parts of generators, turbines, wind turbines, transformers, and household wiring. A string of the circular diagrams represents the processes involved in power generation and transmission. These are structured diagrammatically as a flowchart, with each step in the process, from the power plant to the home, ordered alphanumerically, constructing a chain of cause-and-effect links. Environmental context and human agency are omitted from these diagrams, again representing parts in isolation from the whole, suggesting a biomechanistic view of nature.

Ecomechanistic

The *Science 5* instructional resource presents a shifting view of nature—at times biomechanistic but more often than not, ecomechanistic. This is achieved through a

blending of scientific language (impersonal, passive, technical) and personal, active voice clauses. Much of the student text is directed personally at the students, involving them in a 'dialogue.' Human involvement and agency are frequently included (underlined text); people are actively involved in the production and use of electricity and energy. For example, "Electricity is an extremely important and useful form of energy. We use it to drive electric motors ..." (Activity A1: Student Activity); or "when you turn a light switch on, you close the circuit and allow the electrons to flow" (Activity B2: Student Activity). As well, the more-than-human are not omitted from the text, suggesting an interrelationship and connection. For example, the following text includes humans and the more-than-human (underlined text) in an explanation about transmission lines:

> The transmission towers are huge metal structures that have ceramic insulators to separate the wires from the tower and safely carry the power high above the ground away from people and animals. Transmission towers are linked together along corridors where there are no trees or houses. (Activity B5: Student Activity)

The instructional objectives listed in "Activity A1: Teacher Materials" also include both humans and the more-than-human—another example of a holistic or interconnected view, constructing an ecomechanistic view of nature.

Students will:

- identify several sources of electricity in the natural and human-built environment.
- describe sources of electricity that pose a safety hazard to humans and other organisms.
- describe sources of electricity that are safe for humans and other organisms.

Instances of a biomechanistic view of nature emerge from some of the informational or explanatory text. The language is what Halliday (1998; 2004) and Halliday and Martin (1993) describe as 'scientific', employing middle and passive voice clauses and nominalization, effectively objectifying the physical environment. An analysis of the student interactive, "E3 Online Activity: Build a House," suggests a stance that is mechanical rather than interactive or complex. The presentation is conceptually a classification process or technical taxonomy. Orientationally, the image is a socially impersonal 'offer' of objective information that suggests 'this is how it works' (Kress & van Leeuwen, 2006). However, this is one piece of a much larger body of text. Overall, the *Science 5* resource constructs an ecomechanistic view of nature.

For two of the three electricity/energy instructional resources (*Electricity*; *Energy Literacy Series*), a human-centric, biomechanical perspective dominates; nature is construed as a machine which functions to create and maintain life. Glimpses of an ecomechanistic view of nature are evident in some instances, particularly in *Electricity*. I recognise that the subject matter lends itself to a mechanistic treatment or perspective; however, it is possible to construct a more holistic view of nature. The third resource, *Science 5*, encompasses more inclusive or holistic language that makes space for the inclusion of the more-than-human, and thus constructs a view of nature that is, for the most part, ecomechanistic.

Human-Nature Relationship

Our relationship with nature is inextricably linked with the view of nature we hold. A biomechanistic view of nature is almost always associated with the human-nature relationship Östman (1994) describes as *Exploitation of Nature*. Nature is simply a

resource for human use, exploitation and material gain; the implication is that moral responsibility is limited or non-existent. Similarly, the human-nature relationship *Preservation of Nature* is most often coupled with an organicist view of nature. Within a holistic, interconnected view of nature, nature is regarded as having intrinsic value. This is a biocentric, ethical relationship. *Survival of Homo sapiens* corresponds most often with ecomechanism. This subject focus recognises that humans are dependent on nature. The implication is that *our* very survival depends on maintaining nature's health—this relationship is human-centric, recognising a moral responsibility for future generations of human beings. These are not definitive categories and relationships—the edges are blurred, the subject foci often shifting and blending. However, through analysis of the language and images of the electricity/energy instructional resources, impressions of the embedded dominant subject foci are revealed.

Exploitation of Nature

Both the *Energy Literacy Series* and *Electricity* resources present predominantly a biomechanistic view of nature, suggesting *Exploitation of Nature* is the expected human-nature relationship focus. Similarly, it can be expected that *Science 5*, with its largely ecomechanistic view of nature, suggests a *Survival of Homo sapiens* subject focus. In many instances, this is true, especially for certain sections or pieces of the resources. But, the subject focus shifts within each of these resources, especially in the sections or activities that address issues surrounding electricity and energy production and use.

With its strong biomechanistic view of nature, the *Energy Literacy Series*, overall, constructs an *Exploitation of Nature* subject focus. The text often refers to nature as a resource, explicitly and implicitly, thus signifying nature is a commodity for human use

and exploitation. For example, the following text from the module, "Biomass: Sources of biomass," implies organisms (animals and plants) are a commodity (underlined text): "Biomass for energy comes from many different sources. Material directly harvested from organisms includes: animal fats and vegetable oils, plant cellulose (fiber), starch, and sugar." I realise we produce biofuels from domestic animals and crops, as well as waste from the forest industry and other human activities, but the text serves to construct a particular relationship between humans and other living organisms. This relationship is reiterated in another piece of text in the "Biomass" module—the heading is "Living Fuel"; the accompanying text reads: "Living organisms use and store energy. Green plants use the energy of sunlight .... Animals eat plants and other animals to get their energy. Plant carbohydrates are converted into liquid biofuels through fermentation by yeast and bacteria." Here, living organisms are essentially categorised *as* fuel, a commodity for human use. Additionally, what is omitted from the text is that the organisms (animals and plants) are no longer 'living' once "converted into liquid biofuels." The intent of the accompanying text may have been to describe how living organisms get *their* energy, but the associated heading suggests another possible underlying meaning and relationship.

As noted in the preceding section, *View of Nature*, the *Energy Literacy Series* resource uses grammatical features characterizing the language of science in much of its text. This language acts to remove human involvement in the production of energy—the absence of human participation or agency further alienates humans from nature, acting to construct a human-centric relationship—an *Exploitation of Nature* subject focus. This subject focus "implies that nature is a resource for exploitation by human beings and that

we have no moral responsibility in that respect" (Östman, 1994, p. 145). And while much of the language of this instructional resource suggests such a relationship, the resource does address human responsibility in energy production and use, particularly in the "Issues, Impacts and Outcomes" sections of the modules. The subject focus shifts towards a *Survival of Homo sapiens* relationship with nature—still anthropocentric but recognising moral responsibility and consequences. However, in many instances, the use of middle and passive voice clauses and other grammatical features again act to remove human involvement and agency, perhaps creating mixed messages. For example, in the "Portable Manufactured Devices" module: "Environmentally Friendly?" subtext, the text reads: "The components in most batteries are toxic. Voluntary and legislated recycling programs manage the safe disposal and recycling of portable manufactured devices." This text does not state that *we* (humans) should responsibly dispose of toxic batteries—rather it is the "program's" responsibility. In general, the human-nature relationship construed by the *Energy Literacy Series* resource is *Exploitation of Nature.*

Similar to the *Energy Literacy Series*, the *Electricity* instructional resource predominantly constructs a biomechanistic view of nature (see previous section), suggesting an *Exploitation of Nature* human-nature relationship. Human agency and involvement in electricity production, though implied, is removed from much of the student text "Electricity Tour of Alberta—Facts and Map." For example, in the following excerpts, the 'dam', the 'programs', and the 'plant', rather than people, are the agents: "The Bighorn Dam ... provides hydroelectricity to central Alberta ..."; "Conservation programs have reduced energy consumption ..."; "A biogas ... plant ... near Bruce takes the waste from an intensive livestock operation and ... creates electrical and thermal

energy...." When human agency is removed, the relationship with nature is construed as detached, rather than interconnected, suggesting an *Exploitation of Nature* subject focus.

Survival of Homo sapiens

Three of the student activities outlined in the *Electricity* teachers' guide, however, imply moral responsibility and action, potentially construing a *Survival of Homo sapiens* relationship with nature. The activity "CO_2 Challenge" is intended to help students "link their energy consumption to the natural environment." In this lesson, students calculate their home energy consumption and then use this value to calculate how much carbon dioxide is produced. The discussion questions ask students to understand why it is important to be aware of energy consumption and to think about possible actions they can personally do to reduce carbon dioxide production. This lesson exemplifies a responsible attitude towards and connection with nature but the reasons why are not clear. Are they to ensure the health of the planet is not further compromised for future generations of humans or is it because it is ethically and morally wrong to cause harm to the more-than-human, impinging on their right to survival as well? The reasons underlying responsible attitudes and actions is the difference between the human-nature relationships expressed in the subject foci *Survival of Homo sapiens* and *Preservation of Nature*—the former is anthropocentric, the latter biocentric. The student activity "They Lived Without Televisions" also includes discussion questions intended to help students think about and understand their responsibility and "role in energy use and energy conservation." But in this lesson, the reasons why are mixed: "the conservation of resources"—suggesting a human-centric view; and, "negative impacts ... on the environment"—possibly

suggesting a biocentric view. I say 'possibly' because it is not clear whether the negative environmental impacts concern humans only or include the more-than-human.

The *Science 5* instructional resource incorporates student activities similar to the *Electricity* activities about electricity consumption. The first five student activities in Section E are focused on energy consumption: of household appliances (E1, E3, E4), and homes in general (E2, E5). However, with the exception of activity E4, the reasons why students should be concerned about energy consumption relate to cost savings. For example, in the teacher materials for student activity E1, suggested extension activities include:

- Have students approximate the daily cost to operate each appliance. ... Students or groups could each be assigned a different appliance and as a class could approximate an average household cost for using appliances.
- ... have students research and create a PowerPoint presentation about energy efficiency and/or ways to save electricity in the home.

Since there is no mention of reasons for "energy efficiency" or to "save electricity" other than to save money, the implied motive is human-centric.

Student "Activity E4: EnerGuide Investigation" directly addresses the reasons why people should endeavour to reduce their energy consumption. The text reads: "The EnerGuide label helps us save money and the environment. The less energy we use, the less nonrenewable resources have to be extracted from the environment and burned, causing pollution and other environmental nasties. You can help!" It is not entirely clear, however, whether the reasons are based on a human or biocentric relationship with nature. But given that this instructional resource constructs a predominantly

ecomechanistic view of nature, including the more-than-human alongside the human, the relationship with nature could be construed as *Survival of Homo sapiens*, very possibly *Preservation of Nature.*

Notion of Uncertainty

The notion of uncertainty and how it is discursively managed becomes of greater concern when considering controversial ecosocial/scientific issues. Electricity is not generally considered to be a controversial topic. Humans have constructed considerable knowledge and understanding of this physical phenomenon, although many physicists will argue about its fundamental nature. Generally, however, the language used when discussing the science surrounding electricity is very certain—statements are positioned as truths and facts (bold text)—"electricity **is** energy"; "Electricity **Facts**"; "all matter **is** made of atoms." However, *how* electricity and other forms of energy are produced and consumed can be a topic for controversy, especially concerning the burning of fossil fuels and its relation to climate change.

All three of the electricity/energy instructional resources discuss the consequences of energy consumption in relation to greenhouse gas production and climate change. How each of these resources discursively manages the notion of uncertainty surrounding this issue differs.

The two electricity resources zero in on home energy consumption and its relationship to greenhouse gas emissions. Alberta's dependence on natural gas and coal-fired power plants for the majority of its electricity energy needs is discussed in both resources. One of the first student activities in the *Science 5* resource is "Activity A2: Where Does Alberta's Electricity Come From?" The relationship between Alberta's

"reliance on fossil fuels to generate electricity" and greenhouse gas emissions is made clear—"these emissions **also affect** the global climate change problem." The language is certain (bold text). The language is slightly less certain in this resource's definition of climate change (bold words illustrate certainty; underlined words exemplify uncertainty):

> Climate change: the warming trend in the Earth's temperature. Scientific records **show** that the surface temperature of the Earth **has** risen by about 0.6 C in the last 100 years and the Earth **is** getting warmer faster. Many scientists agree that the climbing temperature **is because of** the increase in greenhouse gasses **caused by** human activities. (*Science 5*: Glossary)

With the exception of the qualifying modal words *about* and *many*, the language is certain.

The *Electricity* resource includes a similar passage in the background information for teachers in the "CO_2 Challenge" student activity. The language in this passage contains statements indicative of certainty or a high level of intensity (bold text) as well as others that qualify the level of certainty or indicate uncertainty (underlined text):

> Many human activities release carbon dioxide and when the amount of greenhouse gases changes, it can have a **significant** impact. **As** the concentrations of these gases increase, **they** intensify the natural greenhouse effect—the earth becomes too efficient at trapping heat. The warming of the earth **caused by** this seems to be resulting in changes in naturally occurring weather patterns.
>
> The burning of fossil fuels to create electricity **is** a **major** contributor to greenhouse gas emissions. To produce electricity both coal and petroleum are

burned, releasing carbon dioxide, **the leading** gas contributing to the greenhouse effect.

The certainty in this passage centres on greenhouse gases—that fossil fuels produce them and that they contribute to the greenhouse effect. The uncertainty lies with the relationship between human activities, greenhouse gases and changes in climate.

Climate change is also alluded to on the poster included with this resource. The inner poster's collage of images includes drawings of a pamphlet and a book; both titled "Climate Change." The pamphlet is in the hands of a homeowner as he lounges out of doors on his patio, presumably perusing materials concerning electricity (other titles on the ground by his side include "Electricity Basics"; "Hot Wires"; "Do It Yourself Electricity"; and "Switch") (see Figure 7). With his mouth hanging slightly ajar, he seems to be wondering about climate change, evidently in connection with electricity. Is he uncertain? What is he uncertain about?

Figure 7. 'Climate Change' pamphlet graphic. (*Electricity* poster)

The second image represents a scientist's laboratory, and contains a book with the title "Climate Change." Two scientists are at work (bubbling flasks, batteries and light bulbs, and formulae chalked on the board are some of the associated images); one scientist is reading a book titled, "Experiments in the Light Arts!", and at his elbow is a well-read book on climate change (many sticky notes poke out of the pages). The book is bright red in colour; drawing the viewer's eye as well as indicating high salience. The top edge of the book borders on the next image in this collage—an outdoor scene of a lake, trees, waterfowl, old-fashioned water wheel and a distant waterfall. Perhaps the message is that climate change is important to think about (it appears to be of concern to scientists, who are usually granted a higher degree of authority and certainty), and that climate change affects the natural environment (physical connection to the natural scene). However, overlying this possible interpretation is the recognition that the images on the poster (with the exception of the photographs representing the various energy sources) are cartoon-like drawings. As such, how much weight or certainty do they convey? These images are low in modality, from a scientific orientation as well as a real-world stance.

The instructional resource, *Energy Literacy Series*, also refers to global warming in the context of burning fossil fuels, specifically petroleum and coal. In the "Petroleum" module the language surrounding this issue suggests both certainty (bolded text) and uncertainty (underlined text). The text reads:

> **When we burn** hydrocarbons, both the carbon and the hydrogen combine with oxygen to produce carbon dioxide .... Carbon dioxide, water vapour, and dinitrogen monoxide **are** all greenhouse gases. (Issues, Impact & Outcomes: The Hydrocarbon Connection)

And:

> Without greenhouse gases, Earth **would be** too cold to support life as we know it. However, the rapid increase in greenhouse gases over the past sixty years is thought to be contributing to global warming and climate change. (Pop-up window hyperlinked to 'greenhouse gases' in previous text excerpt.)

The uncertainty expressed in this text concerning the link between greenhouse gases and climate change is countered in another piece of text from the "Coal" module (bold text indicates certainty):

> When coal **is burned** it releases carbon dioxide, small amounts of carbon monoxide, and oxides that form with any nitrogen or sulphur present. An important challenge to the coal industry **has been** to reduce these emissions, as well as particulates in smoke. Carbon dioxide **is** a greenhouse gas. The oxides of nitrogen and sulphur, when mixed with rainwater, form acid rain. Technologies for dealing with these challenges **are being** developed and improved. (Issues, Impact & Outcomes: Emission Control)

And:

> Greenhouse gases **are** gases that trap heat in the atmosphere, **thus** contributing to global warming. (Pop-up window hyperlinked to 'greenhouse gas' in previous text excerpt.)

This text does not incorporate the notion of uncertainty in the language used. Also, this text, as a long chain of cause-and-effect links, challenges the reader to make the connections among the burning of coal, greenhouse gases and global warming, especially as the text is continued in a separate pop-up window.

Multiple Perspectives/'Bias-Balance'

Two of the electricity/energy resource producers indicate the notion of 'bias-balance' or multiple perspectives is of central importance (underlined text); the producers of the *Energy Literacy Series*—

> The Energy Literacy Series utilizes interactive, leading edge teaching resources that create a multi-media energy program like no other in North America. The program examines 10 energy sources and allows for non-judgmental discussion of its bias-balanced social and environmental content. (SEEDS Foundation)

—and *Electricity*:

> Inside Education™ exists as a centre for education related to the relationship between environmental responsibility and economic development. We work collaboratively with partners with wide-ranging perspectives to provide relevant, engaging, bias-balanced and scientifically-sound support tools and learning experiences for educators, students and the public. (Inside Education)

Both of these resources do incorporate different perspectives or stances on energy issues, but whether or not they could be described as 'balanced' is dubious. Incorporating different perspectives involves more than just stating alternative concerns, issues or points of view. *How* these different perspectives are addressed—the language used—also plays a significant role in shaping perceptions of the various stances.

Energy Literacy Series. The *Energy Literacy Series* text often emphasises economics and cost factors in relation to issues surrounding the production of energy. For example, the leading topic in the "Issues, Impacts and Outcomes" section of the "Petroleum" module is "The economics of it." This section speaks about the importance of petroleum production

for Canada's economy, and states, "an enormous investment in materials and services supports the jobs of thousands of people all over the country." Similarly, the "Geothermal and Earth Energy" module also raises the topic of economics; two of the five topics in the "Issues, Impacts and Outcomes" section relate to the costs and expense of these systems. However, in this instance the concern is that this form of renewable energy production is not economically viable. Taken together, the two texts imply a particular stance or perspective regarding what is most important—costs to humans versus costs to the environment.

A comparison of the headings used for the "Coal" and "Wind" modules' "Issues, Impacts and Outcomes" sections, also reveals an underlying perspective of these two forms of energy (see Table 6). The language used in the "Coal" module is positive—it does not question coal as an energy source—compared with the "Wind" module headings, which are off-putting and imply wind energy is problematic.

Table 6
Comparison of headings of the 'Issues, Impacts and Outcomes' sections

Wind module	**Coal module**
Riding the wind	Coal, electricity, and the economy
Is the power perfect?	Coal and communities
Too noisy?	Living with risk
Bird hazard?	Wildlife habitat
Not in my backyard!	Emission control
How costly?	Zero emission coal
Power to sell	

Electricity. The producers of the *Electricity* resource are also proponents of 'bias-balanced' educational materials. Again, while the materials do present different perspectives, I question whether the term 'balanced' is applicable, or for that matter even possible. Two of the student activities specifically address differing points of view. However, in "What Does it Take to Make Electricity?", the opportunity to address varied perspectives on renewable and nonrenewable electricity sources or the advantages and disadvantages associated with different forms of energy production is found in the extension activities, not as part of the central lesson. "The Lights On!" student activity lists the following learning objective: "students will research the differences in the two types of bulbs [fluorescent and incandescent] from scientific, economical and environmental perspectives." But, the activity's instructions and student questions make no mention of environmental perspectives. The closest it comes is perhaps in point c) in the following text:

> Using the information from the light bulb packages, the *Electricity* poster and the background information discuss the following:
>
> a. Were the results of your experiment accurate?
>
> b. Was there anything that you did not consider in your predictions that you should have?
>
> c. Which light bulb do you now think is the most effective and why?

However, in the context of this lesson, 'effective' likely invokes an economical or utilitarian perspective (i.e. cost per bulb, longer lasting, brighter) not necessarily an environmental perspective.

The *Electricity* poster, with its impressive collage of images, certainly presents information on the diverse forms of energy. The stances or perspectives regarding various energy extraction and production practices will depend on the viewer's interpretation of the poster's images. However, Kress and van Leeuwen (2006) suggest there exists a "grammar of visual design" (p. 15) that encodes experience and communicates visually with viewers. For example, the poster front can, broadly speaking, be divided into three bands of colour: white across the very top (winter scene); brown through the middle (industry); and green along the bottom (agriculture and forestry). Visually, the brown area dominates the image giving it greater salience than the green or white areas. Does this suggest to the viewer that the industrial perspective carries more weight? Possibly. The poster front also includes nine photographic images of the various kinds of energy production. These framed images are not of equal size. The image of a coal-fired power plant, which occupies a central position, is the largest and is visually high in salience. Does this lend this image and what it represents higher status? Again, possibly.

As a final example and an image on the poster front I found quite interesting (see Figure 8): this image shows a beaver with a puzzled expression, scratching his head, as he surveys the recently cut forest of trees. The human wielding the chainsaw, who does not appear to notice the beaver, grins happily. Behind the beaver is a building labelled "ENVIRONMENTCARE." This image pops out from the poster front—not only is the image positioned in the centre of the poster front, the man's hard hat is bright red, and his shirt bright orange. What messages and perspectives might this image convey? Possibly a message about human-nature relationships—a human centric stance as the man has his back to the beaver, implying a certain disdain for the more-than-human. The

"ENVIRONMENTCARE" building positioned alongside the planted seedlings possibly implies a certain perspective regarding forestry—that the forest industry carries out 'environmentally caring' practices. But does the image of the beaver question this stance? Possibly.

Figure 8. Puzzled beaver and forester image. (*Electricity* poster)

Science 5. The *Science 5* producers do not indicate that their materials are 'bias-balanced' or present multiple perspectives. Rather, they stress that their education resources are "designed to bring timely, accurate, and engaging environmental information, tips and support—on topics ranging from climate protection to energy efficiency—to every school in Alberta" (Pembina Institute). The producers intend to advance an environmental perspective, a stance that is evident in the *Science 5* instructional resource.

Though not unequivocally stated, it is obvious that renewable energy technologies are deemed a better choice than nonrenewable energy sources. Similar to the *Energy Literacy Series*, the language used acts to construct a particular sensibility regarding the different forms of energy. For example, the language in the following text connotes a

negative response to the use of nonrenewable resources: "the less energy we use, the less nonrenewable resources have to be extracted from the environment and burned, causing pollution and other environmental nasties" (Activity E4: EnerGuide Investigation). The word "nasties" engenders a particularly negative or unpleasant emotional response. However, it also trivializes environmental damage, as "nasties" is a childish word. In another example, the perspectives regarding wind energy versus energy generated from burning fossil fuels are made clear. The language used to describe wind energy is upbeat and confident, constructing a particular stance (underlined text); whereas the perspective regarding fossil fuels clearly brings into question the wisdom of continued dependence on this energy source (bold text). The following excerpt is taken from the student text in "Activity A2: Where Does Alberta's Energy Come From?":

> There is more and more interest in low-impact renewable forms of electrical generation. The story of Alberta's fast-growing wind energy industry is a case in point. Southern Alberta's Pincher Creek region has legendary winds, blowing steadily out of the west. Massive wind turbines, each of which generates enough electricity to supply more than 20 homes, capture some of this wind energy. ... Generally, while there are ample supplies of coal and natural gas in Alberta, **there are questions** regarding **our long-term reliance** on fossil fuels to generate electricity. The **emissions** of sulfur and nitrous oxides, ash, carbon dioxide, mercury, and **other pollutants** from coal and natural gas-fired facilities **are a major contributor** to regional **air quality problems** in Alberta. These **emissions also affect the global climate change problem**, resulting from gases such as carbon dioxide build-up in the atmosphere. Many believe the solution lies in a

gradual transition to cleaner energy sources such as wind, falling water, solar energy, and hydrogen fuel cells to meet our energy needs.

The perspectives of the producers of the *Science 5* materials are clear; they do not hide behind an approach deemed to be 'bias-balanced'.

Ecological Literacy Dimensions

The three dimensions of ecological literacy, functional, cultural, and critical, are evident in the language and images of the electricity/energy instructional resources to varying degrees. Functional literacy is predominant. The resources centre on science instruction; consequently, information and foundational knowledge is prominent. Throughout each of the three resources, factual information on the processes involved in electricity and energy production is offered. Students are provided numerous opportunities to develop foundational knowledge of the scientific basics of electricity and electricity energy production and consumption (especially *Science 5* and *Electricity*), as well as the different sources of energy found within Alberta and Canada and their accompanying extraction and production practices (especially *Energy Literacy Series*).

Understanding the place in which we live is central to cultural literacy. This is evident in the inclusion of context, particularly the context that is Alberta. Alberta's fossil fuel industry is of great historical, economical, political, and sociocultural importance to the place that is Alberta. Both the *Electricity* and *Science 5* instructional resources were developed specifically to meet Alberta curricular objectives. However, the *Electricity* resource situates Alberta within a Canadian context, whereas *Science 5* focuses solely on Alberta.

The *Electricity* poster is intended to provide information on Canada's sources of electricity and includes images and references to nuclear and tidal energy, energy sources not found in Alberta. The poster also incorporates images representative of some of the different geographical features of Canada, especially those features pertinent to energy production and consumption. For example, Canada's cold, northern climate is illustrated on the poster front, indicative of our increased need for heat energy. As well, the prairie landscape, suitable for wind and biomass energy sources, is illustrated, as are cityscapes and their requisite demand for energy. The collage of images can be interpreted as providing a broad cultural context for understanding electricity and energy production and consumption patterns in Canada.

The *Science 5* resource includes text that situates the production and consumption of electricity energy in an Alberta context. The "A2 Online Activity: Electrical Energy Generation in Alberta" provides information on the various sources of energy produced in Alberta. This information is primarily foundational, but cultural aspects are also evident. For example, the following text suggests understandings of the historical and cultural context that underpins Alberta's dependence on fossil fuels: "Alberta contains lots of coal. Coal deposits are found across much of the province"; "Natural gas reserves are found across Alberta ... It is not hard to find a good location for a natural gas generating station"; and, "Because there are not enough large rivers in Alberta the generating capacity of hydroelectric stations is relatively small."

The *Energy Literacy Series* situates energy production in a Canadian context. Information on why some of the various types of energy are positioned where they are is included in several of the modules. For example, "Canada, with its vast size and varied

topography, has many regions that are well suited for harnessing wind energy" (Wind module). This resource also includes a historical context for some of the different energy sources. The following text examples highlight historical uses of biomass, coal, and wind energy: "humans have always burned wood for heating and cooking" (Biomass module); "coal was the most important energy source during the Industrial Revolution" (Coal module); and "humans have been harnessing wind energy for hundreds of years" (Wind module). Snippets of text and images in the three resources provide a sociocultural and historical context for understanding the political and economic dimensions of energy production in Alberta and Canada; understanding necessary for critical ecological literacy.

And finally, critical literacy, which is dependent upon both functional and cultural literacy, is expressed in the notions of decision-making and action. While the *Energy Literacy Series* provides fairly in-depth foundational knowledge about the different sources of energy, as well as a cultural and historical context for several of those sources, this resource does not include personal action suggestions for students. A few very general comments or hints about possible citizen actions to reduce energy demands are mentioned, for example, "the most convenient pattern of personal transportation—one person in one vehicle—contributes unnecessarily to unwanted emissions in every situation where the traveller could use an alternative" (Petroleum module). As well, some of the issues relevant to the decision-making processes concerning energy production are included, for example,

> The decision to mine the coal depends on many factors, such as how close the coal is to the surface and to rail lines, the costs involved in mining and processing,

the demand for the coal type, and the social and environmental impacts involved" (Coal module).

Interestingly, the only energy module to list environmental impacts as the first order of concern is the "Hydro" module; economic concerns are generally given prominence.

Both the *Science 5* and *Electricity* resources directly address actions students can personally take to reduce their own energy consumption and consequent impact on the environment. This is achieved through an understanding of the link between electricity use and the production of greenhouse gases by fossil-fuelled power generating stations in Alberta. Some suggested activities include poster campaigns: "have students design and create posters or signs to increase awareness of energy consumption. The posters could be displayed either at home or at school and should be action motivating ... or awareness generating" (*Science 5*: Activity E1); or, reflecting on their own energy use: "brainstorm a list of responsible energy use and electricity saving measures which students follow at home and at school. Challenge students to be particularly 'Electricity Smart' for a week" (*Electricity*: They Lived Without Televisions). Personal actions people can take to reduce their energy consumption are also represented on the *Electricity* poster through slogan 'billboards' and other images. Example slogans include, "Lights out when your out!"; "Shorter showers make cents!"; and, "Exercise your fingers and turn OFF the TV and computer."

In summary, the analysis of the nonliving systems instructional resources—resources centred on the physical sciences of electricity and energy—reveals the language and images of these materials construct a predominantly mechanistic and atomistic discourse. Certainty, functional ecological literacy, and the informational and technical

language of science (Halliday, 2004; Halliday & Martin, 1993) dominate, especially in comparison with the discourses of the living systems instructional resources. This is due in large part to the subject matter of these resources. However, regardless of the topic the discourses of the materials construct a particular perspective about and relationship with nature.

In my analysis of the textual resources I recognize that meaning is not determined by the text alone—children are co-constructors in meaning-making as they interact with the text. Additionally, I recognize that teachers play a dynamic role in mediating the messages embedded in instructional resources. However, "educational texts are institutionally defined" (Kalmus, 2004 p. 471) and as such carry a certain authoritative weight, shaping children's thinking in specific ways. The findings illustrate how the discourses of these semiotic resources offer students a particular perspective, acting to shape their identity, personal relationships with nature, and environmental consciousness. In the next chapter, I turn to an interpretive analysis of the interview data, interviews conducted with the producers and/or writers of classroom resources.

CHAPTER 6: INTERVIEW ANALYSIS AND FINDINGS

For this research study, six interviews were carried out and included in the analysis: one conducted with Amy,[12] a provincial government representative from the environment ministry (Organization A); and five interviews with representatives from three different not-for-profit, nongovernmental organizations (NGOs). The NGO Brian and Fiona work for is based solely within the province of Alberta (Organization D). Its role centres on science/environmental resource production, teacher professional development, and direct delivery of programs to students. The second NGO, Elaine and Deven's, has connections nationally but operates predominantly out of Alberta (Organization C). This NGO's role centres primarily on environmental policy research, but also includes education and instructional resource production. The NGO Gwen works for operates nationally but is based in Alberta (Organization B). This relatively new NGO (founded in 2002) is strongly connected with industry—their role is to provide information on the energy sector (see Table 7 for a summary of organizations and interview participants).

Though numerous themes and subthemes were identified and subsequently coded (see Appendix E), I have chosen to focus this analysis in two directions; first on the five a priori themes derived from the literature and my theoretical perspective: 1) view of nature; 2) human-nature relationship; 3) notion of uncertainty; 4) multiple perspectives or 'bias-balanced'; and 5) the dimensions of ecological literacy—functional, cultural, and critical. Second, I will examine three additional themes that notably emerged from the interview data and are of particular interest and salience to this research: 1) place or role

[12] All participant names are pseudonyms.

of the organization in environmental science education; 2) curricular connections; and 3) corporate involvement in environmental science education. Other subthemes are interwoven throughout this analysis. The ideas and concepts that emerged from the interview data frequently interconnect and interact; they cannot be fully teased apart.

Table 7
Organizations and participant affiliations

Organization	Subcommunity	Participant/Role
A	Provincial government environment ministry	Amy – manager/producer
B	NGO – national operation; head office in Alberta; provides information on energy sector.	Gwen – manager/producer
C	NGO – national operation; head office in Alberta; environmental policy research and education. Education arm separate office.	Elaine – manager/producer/writer Deven – writer
D	NGO – provincial (Alberta) operation; resource production, PD, and direct program delivery to students (classroom and field trips).	Brian – manager/producer/writer Fiona – writer/PD and school program delivery

I have included an analysis of the a priori themes because these themes are central to my research questions and the critical discourse analysis of the instructional resources. I initially approached the interview transcripts believing (hoping) these themes would be prominent in the interview data. After all, it would make it easier to 'find' answers to my questions. However, while present to some extent, most were not the predominant themes to emerge from the analysis of the data. That is interesting in and of itself. The one exception is multiple perspectives or bias-balanced—this theme was very evident in several interviews. If these constructs or themes are central to environmental science

education and ecological literacy, as I believe them to be, then why did they not emerge more prominently from the words and thoughts of the resource producers? I recognise that this is due in large part to the questions that were asked and the turn the conversations took. But I also believe these concepts are not necessarily forefront in the minds of the resource producers. Why aren't they? I can only speculate as to the reasons why but suspect they may, at least in part, reflect the organizations' mission and vision statements, goals, and principles.

View of Nature

Language is revealing. The language and visual text in the resource documents 'speak' volumes about the natural world, constructing a particular stance or view of nature. Similarly, the view of nature the participants hold can be surmised, to some extent, from the language they choose as they speak about nature and the natural environment. Unfortunately (or perhaps, interestingly) nature or the natural environment was not often talked about or referred to during the interviews. As a consequence, it is difficult, perhaps impossible, to describe the participants' views regarding nature in accordance with Östman's (1994) descriptors, as I attempted in the analysis of the documents. Regardless, based on our conversations, I infer that some of the participants might be most closely aligned with a biomechanistic view. According to Östman, a biomechanical nature language "expresses the view that nature functions as a machine and its purpose is to create and maintain life" (p. 148). When the natural environment is referred to in terms of 'use' or 'management' or by language that suggests nature exists primarily to support human existence, nature becomes metaphorically a machine. I asked

Fiona if she would describe her organization as an environmental organization—she replied she would not. In the course of explaining why not she said,

> Looking at the province, looking at everything that's out there... at all the natural resources that are across there. Looking at the very *limited* amount of resources available to everybody. If everybody wanted to take what they wanted they can't, it's not possible, you can't do that. And all of those decisions that come into play about how we are going to divide all of that up, how everybody is going to use it and that includes the natural environment as well so not just humans but everybody or every*thing* that needs some of that space.

In the language Fiona chooses, nature comes across as being made up of bits and pieces (as are machines); it is something for humans to 'use' and 'divvy up'. She does recognize that the more-than-human also have needs, but not from an interconnected or ecological awareness. In a similar vein, Amy speaks about "sharing responsibility for managing the environment." Management suggests control and power.

Brian talks about the environment and natural resources as two entirely separate entities—"that's the Alberta advantage I think. In talking about education about the environment and natural resources" and "there are two areas ... we saw all kinds of opportunities dealing with environment and natural resources which is what we do." I recognise that 'natural resources' is not synonymous with 'environment'. The *Concise Oxford English Dictionary* (2002) defines 'natural resources' as "materials or substances occurring in nature which can be exploited for economic gain" (p. 950). The Alberta Social Studies: Grade 4: Alberta: The land, histories and stories (2006) defines natural resources as:

> Elements of the natural environment that are of use to humans. They include non-renewable and renewable resources. Non-renewable resources, such as oil, natural gas and minerals, are limited in quantity; renewable resources, such as forests, water and fish, can be regenerated and can last indefinitely if used carefully. (p. 12)

And environment is defined as: "1. the surroundings or conditions in which a person, animal, or plant lives or operates. 2. (the environment) the natural world, especially as affected by humans" (*Concise Oxford English Dictionary*, p. 477). 'Natural resources' and 'environment' do not mean the same thing but they are connected. When we extract and use resources we affect the environment, most often negatively. If environmental science educators only refer to the two as separate entities, then the interrelationship between the two can become blurred. Without that awareness of their interconnection, the language and view of nature is biomechanistic. This particular view of nature is usually associated with the human-nature relationship of human beings as exploiters of nature.

Human-Nature Relationship

Realizing the human-nature relationship constructed through language—the words and ideas expressed by the interviewees—is not a simple task. Their notion of the human-nature relationship is implied in their words; it was not a topic explicitly addressed. Nevertheless, there are some indications of the participants' stances regarding human relationships with nature.

When nature is spoken about in terms of resources, management or use, Östman (1994) would describe the human-nature relationship as *Exploitation of Nature*. Again, this subject focus refers to how "human beings have used or can use nature to promote

their material welfare. ...[It] also implies that nature is a resource for exploitation by human beings and that we have no moral responsibility in that respect" (p. 145). This stance comes across when the emphasis is placed on natural resources and development, and ignores the needs of the more-than-human. In speaking with Brian and Fiona, it appeared their organization was shifting somewhat in that direction; moving from an initial focus on environmental education to a focus on "science, issues, development and environment." However, there is still an emphasis on the environment and a suggested moral responsibility. As such, the human-nature relationship might better be described as *Survival of Homo sapiens*. This subject focus suggests "human beings are dependent on nature, which implies that the survival of *Homo sapiens* is dependent on the well-being of nature" (Östman, 1994, p. 146). But this stance is still human-centred or anthropocentric; awareness of our interrelationship with the more-than-human is muted or non-existent.

A similar human-nature relationship (*Survival of Homo sapiens*) emerged from the conversation with Amy. In speaking of a shift she sees occurring in society, she said,

> It's changing. It's different in schools, but they [students] still need to have that understanding that's how environment is being managed. You will grow up and some of you will be asked to have a personal stewardship role *over* [italics added] the environment and that public expectation to be a steward is increasing.

Amy recognises a moral responsibility evident in "personal stewardship," but describes that role as being *over* the environment, not as part of. The implication is we need to be managers or keepers of the environment for human-centred reasons. This sentiment is also expressed by Fiona. In talking about herself and the people who work in her organization, Fiona said,

> I guess if you wanted to look at ourselves on a scale, I'm definitely more towards the management side of things but that's my background. I came through forestry and forest management and sort of from the human side of things.

But she continues on to say, "we have some [staff members] that are very much the environmental—not hug a tree kind of thing, but preservation, conservation that kind of thing." This suggests two things to me. The first is, with the organization personnel's varied backgrounds and beliefs about human-nature relationships, the human-nature relationship of the organization might be described as *Preservation of Nature*. In this subject focus nature is viewed as having "intrinsic values which human beings do not have the right to violate. ... It is biocentric, or nature-centred" (Östman, 1994, p. 146). However, and this brings me to my second point, this biocentric view is negated by Fiona when she is quick to say "not hug a tree kind of thing." She backs away from the notion of connecting personally with nature on a spiritual or nature-centred level. Her view seems very much anthropocentric; her relationship with nature—*Survival of Homo sapiens*.

In several participant interviews the conversation turned to children and their connection or relationship with nature. We talked about the importance of providing children with opportunities to engage with nature, whether they reside in urban or rural areas. Brian and Fiona's organization is involved in direct delivery of programs to schoolchildren. Both saw value in helping children make some manner of connection with nature. Brian, in speaking of their field trip programs, commented:

> Getting your hands dirty, getting eaten by mosquitoes, and all those sorts of things. We think it's absolutely critical. ... We get kids who their entire nature

> experience has been maybe going skiing, maybe going to Banff and going to the candy shop and going home. And they've got it [parks/nature] right in their back yard. ... We get city kids that they're—wow! And providing that opportunity is something that we greatly value. We spend a lot of time doing that too.

Fiona also spoke about the importance of building a relationship with the out-of-doors, even if only in the schoolyard:

> We've done classroom presentations where we try and get them out at least into the schoolyard. So if we go in we'll do a program where they're actually doing a stewardship type activity in their schoolyard; where they go out and plant trees or a garden or something similar to that in the hope that they take a little ownership of that particular small little place on their schoolyard. ... So you're trying to build that connection in there. ... It's not the *same* as getting them outside of the city but it's at least getting them connected to the natural environment to some extent.

Furthermore, Fiona commented on the difficulty often encountered in building that connection: "we've tried to [through videos] *bring* the forest *into* the classroom. ... But a lot of that is ... it's tough; if a child only lives in downtown Calgary or downtown Edmonton and never gets out." Fiona's comments regarding children and their relationship with nature seem to contrast somewhat with her earlier comments surrounding her own human-nature relationship. But she does use the words 'stewardship' and 'ownership', implying a relationship that is still human-centred.

Deven's organization does not provide direct delivery programs to children, but she saw some possibilities for helping children connect to nature through their online resources. In speaking about the resources they produce, Deven said,

> We have students all over in different rural and urban—and one thing I thought [our resource] offered was the students who might not necessarily get to the mountains could do the science [program] and—we have got oh probably hundreds of photos of locations all over Alberta that they might not actually see for a really long time and it kind of helps them picture what's out there and what kind of flowers are in the mountains, foothills, or in the prairies, and things like that. It gave them an opportunity to engage in environmental content in a *different* way. There's a lot of 'on the ground programs' that do sort of the outdoor activities and I think the online component is nice because it's another access point, so if students don't like going outside or don't like the environment or don't really care to see nature, and they're out there. And adults too. It gives them a way of engaging with environmental material without having to go outside and it may, because it is online, it may draw them in.

It is an interesting notion—developing a human-nature relationship through online interaction. Nonetheless, Deven does regard some manner of relationship with nature as important. It is difficult, however, to ascertain her relationship with nature.

The language we choose as we speak about nature and the environment can imply a particular stance or relationship with nature. This human-nature relationship is evident to some extent in the language of the participants. It is also evident in the language and

images of the educational resources; perhaps reflective of the stance towards nature the producers and writers of the resources hold.

Notion of Uncertainty

Several participants spoke about the importance of being factually accurate in the content of the resources. In reference to the resources they produce Brian stated, "... are we being factually accurate ... that's what's important." Elaine, referring to her organization's partners in resource production, mentioned the importance they placed on factually accurate content: "The area that got the most scrutiny from them was our climate protection section. That was all about the factual content on climate change." Deven also commented on the pressure she felt to be accurate, "it was pretty important to get those numbers right. So making sure we had the right CO_2 factor, things like that." In a similar conversation about her organization's review process for resource production, Gwen said, "any of our original content is stakeholder reviewed ... to really ensure that the information in the book was factually accurate."

Factual accuracy, particularly regarding controversial issues, is nigh on impossible. Fiona spoke of this difficulty:

> That the information is factual ... is probably one of the toughest things. 'Cause you can go to one government organization that has these statistics, you can go to one industry organization that has these statistics so there's a lot of going back and forth to figure out how we're going to use this or do we just need to drop that statistic and talk more generally because there isn't consensus.

For many environmental issues public consensus is not clear or has not been reached. Issues such as climate change, exemplify ecosocial/scientific issues on the frontier of

science. These are issues that demand "decision-making in conditions of uncertainty" (Mayer, 2005). The importance placed on factual accuracy, even within controversial topics, influences how uncertainty is managed within the resources.

Multiple Perspectives / 'Bias-Balance'

The notion of bias-balanced education or presenting multiple perspectives is particularly intriguing. The participants who strongly promote bias-balanced education view the terms 'bias-balanced' and 'multiple (or different) perspectives' as synonymous; the terms are used interchangeably. But are they synonymous? The noun 'perspective' is defined as "a particular way of regarding something" (*Concise Oxford English Dictionary*, 2002, p. 1066). Thus 'multiple perspectives' refers to the many ways something, such as nature, may be regarded or viewed. The noun 'bias' is defined as "inclination or prejudice for or against one thing or person"; the verb 'bias' means to "influence unfairly; prejudice" (*Concise Oxford English Dictionary*, p. 130). Bias has a negative undertone—'prejudice'; 'unfairly'. But perhaps 'bias' means something altogether different conjoined as it is with 'balanced'. The noun 'balance' is defined as a condition in which different elements are equal or in the correct position" ; the verb 'balance' means to "offset or compare the value of one thing with another" (*Concise Oxford English Dictionary*, p. 101). Joined together, 'bias-balanced' becomes an adjective, as in 'bias-balanced education'; an interesting example of grammatical metaphor (see Halliday, 2004; Halliday & Matthiessen, 2004). Does this change in grammatical class alter the meaning to the extent that the word 'bias' no longer carries with it a negative connotation?

The Alberta elementary science and social studies curricula use the terms 'perspective' and 'multiple (or diverse/different) perspectives', but never the term 'bias-balanced'. The word 'bias' does appear in the social studies curriculum in the context of detecting or examining bias, for example "examining bias and distinguishing fact from opinion" or "detect bias present in the media" (Alberta Education, 2005a, p. 2). The word 'bias' is not used synonymously with 'perspective', but rather is juxtaposed, as in "determining diverse points of view, perspective and bias" (Alberta Education, p. 8). And yet, the term 'bias-balanced' appears in four of the six interviews. Why the emphasis on 'bias-balanced' in the production of environmental science resources? Is 'bias-balanced' the new catchword in environmental education, at least for some? Is it, perhaps, a promotional contrivance?

The NGO Brian and Fiona work for is especially focused on providing what they perceive to be bias-balanced education. Brian stated, "everything that we do is based on the concept theme of bias-balanced so multiple perspectives." Similarly, Gwen, Elaine, and Amy commented on the need to present multiple perspectives or "different voices"; though Amy stressed the necessity of ensuring "corporate messaging is captured" in the government resources. Gwen commented, "we wanted to make sure what we were developing within our information resources was going to be accepted by *all* audiences and not to be seen as biased or advocating for industry." In speaking of the standards they maintain for their resources, Fiona stated, "I think it [the resources] addresses, if not equally, at least balances out some of the different perspectives. So it's not just industry focused, or government or land management focused or just environmental community

focused. It kind of covers all of those." The only participant who questioned the notion of bias-balance was Deven. She stated,

> I have a hard time with bias-balanced because my interpretation of that is it was a 'funder' requirement and as soon as someone says that, I find it hard to buy in. Immediately it puts the red flags up. Why do you have to state that? Is something going on?

Deven is referring to the requests by the various financial sponsors (government and corporate) of these resources to include alternative perspectives (including the sponsors' own) in an explicitly stated, bias-balanced approach.

In speaking about her organization's guidelines for resource production, Deven spoke further on the topic of bias-balance,

> ... Trying to be as fair as possible in the content. Because ... for education there are certain things you do, there are certain things that you don't typically do. It has to be—I don't want to say bias-balance. I think if we are going to be biased then we state that bias and then there would be a discussion component. ... It depends on the context of the actual piece that you are writing, so you may actually write a piece that is *not* bias-balanced. It may actually be very much geared towards the environmental objectives.

The notion of bias-balance is indeed intriguing—is bias-balance even possible? Is it desirable? Is it a slick marketing tool?

Dimensions of Ecological Literacy

Similar to the analysis of the print documents, I draw on Stables' (1998) tripartite model to explore the various notions surrounding the dimensions of ecological literacy

that emerged from conversations with the producers and writers of the instructional resources.

In reference to her organization's criteria or principles for resource production, I asked Amy if her organization focused primarily on environmental concepts when developing a resource, or if they put science first, weaving environmental ideas within the science learning objectives. Her reply touched upon all three dimensions of ecological literacy:

> I think so. I think when we develop a resource we want to walk people through—let's use water as an example—water basics 101. But our ultimate goal is to move them from water basics 101 to things you can *do* to make a *difference*. So here's a little bit of the science, here's the challenges in Alberta today, and here's how you can take action on those challenges.

Amy recognised that in order to be able to "take action" on environmental issues, people need to understand both the science or ecology and the physical, political, and cultural context of the place in which they live. Fiona expressed very similar ideas when asked about her organization's guiding principles for resource production:

> So there's an activity that focuses on, for example, on water, so the science of water. And there's an activity that looks at what are some of the concerns, what are some of the issues in Alberta about water. There's an activity around what are some of the things that are done, what can you do, some personal action types of things as a student.

As did Amy, Fiona intuitively recognised the importance of including all three dimensions of ecological literacy.

In my analysis of the interview data, I also separated the broader theme of ecological literacy into three subthemes centred on each of the three dimensions. In doing so, I was able to draw out instances where each of the subthemes emerged from our conversations. The importance of functional ecological literacy surfaced from Gwen's words. I asked Gwen why she saw a need for energy education in the K to 12 system. She replied,

> ... I think educating the K to 12 audience helps bring that dialogue back into the household. Might broaden some of the knowledge and understanding and work to dispel some of the misconceptions there may be on energy. ... And then that allows the students to be more aware and informed of their choices and of the role they will play in ensuring a secure and reliable energy future.

Gwen stressed the importance of foundational knowledge, knowledge about energy. Armed with that knowledge, students will be able to make informed choices—this speaks to critical literacy. Similarly, Amy talked about the necessity for government policy makers to have a solid knowledge basis or foundation: "for the people who are up here, making decisions, they need to have systems in place that help them [have], not just a general understanding, but have a really good foundation in the topic area in order to make a decision." The ability to make informed decisions essentially equates to action. Functional literacy is expressed as a dimension of critical literacy.

Cultural ecological literacy is often more subtly articulated. The notion of context or place speaks, in part, to cultural literacy. Alberta is our place, our context. In reference to their professional development program on electricity, Brian spoke about Alberta: "we're going to talk about the fact that 85% of the energy, the electricity produced in

Alberta, is from burning something. It's not from water and wind." His statement is more than foundational information. It also hints at the historical and cultural context that is Alberta. The province's structural and economic focus and dependence on fossil fuels is a large part of what makes Alberta, Alberta—it is part of the political makeup that informs environmental decision-making and consciousness.

The implication of cultural literacy is also evident in Amy and Fiona's comments: "the environment is the number three priority that Albertan's have identified" (Amy); and "[Aspen parkland, it's disappearing (Interviewer)]. Very much so. And very multi-use" (Fiona). Amy speaks to Albertans' value system. Fiona's comment harks back to the cultural understanding and relevance of place—how it is that a unique ecosystem, such as the Aspen parkland, can play a role in shaping society.

The importance of action was emphasised by several participants, suggestive of critical literacy. Both Deven and Elaine commented on their organization's recognition of the importance of action and including action components in their resources. Deven, in talking about environmental education remarked, "action has been a real big push in the last few years." Similarly, Elaine spoke about the role of environmental education in "providing them [students] some options of taking action, but it's usually taking personal action. ... Education is empowering our youth with the skills, knowledge, and attitudes that will be able to sustain the energy for the future." Amy's comment recognises that action does not necessarily follow from knowledge, hinting at the importance of personal connection: "we could create fact sheets and brochures and displays out the wazoo but that doesn't translate into *action.*" And finally, Fiona talks about what she hopes children will learn from their field programs:

> I think ... understanding that when they go out camping on the weekend ... that ... they might think about, 'Oh, I know what that tree is' or 'I know what that plant is' or 'I learned something about the fish that swim in that particular stream that's out there. I know a little bit about that.' They have a bit more of a connection to it. And they'll maybe think about when they are with their older brother or sister and they want to plough through on their dirt bike, through that stream and there is a bridge just down the way that maybe they'll think 'Oh, you know what, I have a bit of a role to play in this whole thing too. If I take that bridge, I'm reducing the impact that I'm having on that particular ecosystem.'

Fiona's comments draw attention to how each of us can act to reduce our personal ecological footprint. Her comments also highlight how each of the three dimensions—functional, cultural, and critical—are crucial elements of ecological literacy.

The analysis of the interview data suggests that all of the environmental science resource producers believe in the importance of a multi-dimensional approach to environmental education. Whether they are conscious of it or not, they recognise that knowledge, awareness of context or place, and critical thought and personal action are all necessary for ecological literacy.

Role of Organizations in Environmental Science Education

Not surprisingly, the four organizations have different notions of their respective roles in environmental science education, especially given that their central foci are diverse. However, one common thread is to provide information; there is a perceived deficiency in instructional resources and teacher professional development for elementary environmental science education in the province of Alberta. All four organizations felt

they could, in part and to varying degrees, fill this deficiency. The emphases placed by the organizations on providing instructional resources, teacher professional development and/or other educational services for the K-12 system differed depending on the organization, ranging from 20% of time and organizational resources (Organization A) to 100% (Organization D).

Science/Environmental Resource Production

The predominant reasons given for the organizations' involvement in resource production are to provide information—oftentimes information perceived to be missing—and to support teachers with needed classroom resources. Gwen, in speaking of energy education, stated, "there is a real gap in the demonstrated need for better information." Brian commented that teachers "need the tools and resources to be able to meet their needs." When asked if she felt it important that the materials are produced, Amy replied,

> Teachers really like the resources because they're free. And a lot of other resources out there there's a fee for, and funding's tight so it creates a barrier to access. *That* is the biggest feedback. They like it, number one, and it's free.

Whether because of costs or a paucity of suitable information resources, the organizations feel they have a role to play in meeting classroom needs through instructional resource production.

I asked if there were specific criteria or guidelines they follow when producing the resources. With the exception of the government representative, all of the NGO representatives stated there were definitely clear guidelines, principles or mission statements that they followed. Gwen's organization does not actually produce resources but rather partners with other organizations to do so. She stated their partners followed

"similar ... models that makes sure everything is stakeholder reviewed and factually accurate and non-biased and not advocacy focused." Brian's response to my question—"absolutely. Bias-balanced so multiple perspective, curriculum connected, interactive as much as possible, multi-media at times ... and then supported and supportable." Elaine and Deven represent the education arm of a large NGO, and as such conform to the organization's overall mission statement. Elaine stated, "we have four main areas that we focus on topic wise: reducing greenhouse gas emissions, reducing the impact of conventional energy use, increasing energy conservation efficiency, and increasing the use of low impact renewable energy." Clearly stated goals or mission statements are very likely a prerequisite for funding for nongovernmental organizations.

Teacher Professional Development

One of the NGOs (Organization D) is wholly an education organization. The organization provides instructional resources (developed in-house or in partnership), teacher professional development, and direct delivery of programs to youth through field trip opportunities and classroom presentations. They consider teacher professional development (PD)—what they are "known most for"—their primary educational purpose. Through the interviews with Brian and Fiona, it became clear that teacher PD is considered "critical," especially for elementary teachers in science education. PD is seen as necessary to increase teachers' subject knowledge, expertise and confidence. They view their PD programs as extending beyond the usual "Grade 6 Trees and Forest workshop." Brian commented, "it's personal as well as professional development for the teachers. ... it's not a workshop; it's not an in-service ... it's capital P capital D professional development we think."

The other organizations do not place as great an emphasis on teacher professional development. (Organization B is not involved in teacher professional development except through the sponsorship of partners who do deliver PD.) This is likely due to the organizations' structure and mandate, which do not set teacher professional development as a primary purpose. The organizations respond to requests to provide PD, but do not actively promote or seek comprehensive PD opportunities. For these organizations, as well as Organization D, teacher PD occurs, in part, as a consequence of the marketing and promotion of materials. Professional development around resource use, in the form of workshops at teachers' conventions, conferences and other venues, is seen as one way to get teachers to use the materials in their classrooms. As Brian said, "we want to motivate people [teachers] to understand how this is going to meet your needs, what's so great about it, get them excited about it."

The reasons behind providing teacher professional development also relate to the view of teachers held by the organizations and their personnel. For some, there is a perceived 'lack' or shortcoming in terms of teacher subject knowledge, expertise and/or confidence, especially regarding science education and elementary teachers. With this view in mind, the organizations see their role in professional development as essential. Gwen commented that there is a "need for teachers to better understand the resources so they can speak to them more knowledgably." Following a similar line of thought, Fiona said,

> On the last day of every program [teacher PD] I'm always amazed at what people [teachers] write on their evaluation forms or what they say to you about the stuff that they didn't know. ... And stuff that seems to me common sense or logical,

> the amazement on people's faces, teachers' faces when they come out on stuff, it shows you that, you know what, this is something that needs to be done.

When I asked Brian if he felt PD was a primary goal for their organization he stated, "I think PD is critical. You can produce all the videos in the world and it's going to collect dust if a teacher doesn't understand *why* they need to know it." The implication is that teacher professional development is very much needed to 'provide' teachers with knowledge, especially concerning resource content.

However, not all organization personnel seem to be in agreement with this particular view of teachers. Though not explicitly stated, others appear to view teachers as capable professionals who are essentially overworked with too many demands on their time. With this view in mind, the professional development opportunities are meant to support teachers in their educational activities. When asked if she thought there was a need for more professional development for teachers, Elaine replied, "in the online world, yes," possibly implying that she did not believe teachers were in need of PD in other areas. When posed the same question, Deven responded,

> I think PD is needed, but I wonder whether there needs to be a PD review. Going back to the teacher conferences, there are some issues of teachers who have taught for a while and there's very few sessions in their specialty and they're way beyond what that session's offering. I think PD can be really good but I think it can also really be a waste of time for teachers. And I see a lot of teachers come to PD and they're burnt out, they're tired. They drink coffee because they are so burnt out and I don't blame them. And then there're the other teachers who are

really high end; it's really hard to meet their needs because their knowledge level is so high it's tough to keep pace with that type of knowledge.

These differences in the view of teachers are subtle, but they are nevertheless there. The differences are evident in their tone and way of speaking when talking about teachers and teacher professional development.

Changing Role of Environmental Education Subcommunities

The role organizations play in environmental education appears to be undergoing change. Amy commented, "the expectations that are being placed on government and the new governance role that we're taking would be moving [the government] away from the [K to 12 education system]" to public education. She felt this reflected a shift, in part, to a more active, participatory role on the part of the public, thus the need for a change in focus to "community-based social marketing." They are turning more to partners for any new development of instructional resources, maintaining overall control while providing the necessary funding. Brian commented on the very strong growth his NGO is experiencing in providing educational resources, school program delivery, and especially, professional development for K to 12 teachers. Similarly, Deven and Elaine's organization is in the process of expanding their educational division to other provinces, specifically British Columbia and Ontario. To accommodate this growth, both NGOs have had to rely on corporate sponsorship.

The changing role for environmental education subcommunities may be, in part, a reflection of societal changes. Amy spoke about changes in society:

Look at how society is changing. They're moving from affecting the environment with their vote to now sharing responsibility for managing the environment by

being involved in watershed basin councils and stewardship groups. There's a land use strategy coming out and there will be people sitting on councils that make decisions there, so it's much more heavily *action* oriented.

This changing role may also be a reflection of changes within the environmental community in terms of becoming, as Deven put it, "more strategic" in their approach to environmental communication and education. Deven said, "from when I started in environmental ed and today, I think one thing I've noticed is the environmental sector and the environmental education sector is becoming seemingly more sophisticated in its approaches to create change." She went on to speak about changes in the environmental sector in general:

> In terms of the overall environmental sector I would say it's starting to be aware of the fact that they are not always good *communicators* in the public arena. Sort of the perception of environmental communities is that they're activists, they're critical, they're in your face, they want all these bizarre interventions to save the Earth. And so I think the community as a whole is starting to look at how do we appeal to the conservative populace, how do we speak their language, how do we get them on board, how can we remove barriers so that they can carpool or reduce emissions, things like that. So being, I think, quite a bit more strategic. So instead of saying we've got to implement renewable energy, we say what kind of future do you want for your children. We are starting to look at ways of communicating in a way that makes sense to the non-environmental population, and *appealing* to those people.

Fiona also spoke about the changes she saw in environmental education:

> I think environmental education nowadays—it's sort of changed. The term environmental education has certainly changed from the 70s when it was kind of started or coined I guess. At that point in time it's sort of gone through some evolution. The 80s was very much a ... if you were an environmental education society it was all about hugging the trees and going out and being one with nature. In the 90s it kind of brought in some of the social stuff, brought in a little bit of the economic stuff. I think nowadays it just doesn't work for us because we bring in so much of the talking about industry, the role of industry, about the role of government in managing the land, all of those different things. If you say environmental education then people miss that there's other things, those other things that are involved. Talking about how the public sees the management of our natural resources. When you talk environmental education I don't think people think about that or their role to play in that.

Fiona's comments are particularly interesting. She presents a view of environmentalism and environmental education, as did Deven, as being 'out there' or unacceptable to the "conservative populace"—as 'tree huggers' and "activists." But the approach Fiona's organization has taken is to re-brand itself; distance the organization from the environmental education label. I asked Fiona if she would describe her organization as an environmental organization. Her reply—"I wouldn't." She later commented, "we used to say environmental education resources, but now we just [say] education resources." Perhaps the change to talk more about the role of industry and land management reflects a shift that may be a consequence of increased corporate/industry involvement in the environmental science education sector.

Curricular Connections

With one exception, all interview participants stressed the importance of producing materials with obvious connections to the curriculum. Brian stated, "certainly curriculum connected. We don't do things unless there's a curriculum fit for it." It was expressed that if teachers could not immediately see the curricular links they would not use the resources. Amy said it is "really important that you demonstrate the link for them [teachers] from the curriculum they are required to deliver, and show how what we have ties into it, make it *obvious*." This appears to be a 'lesson learned'; the organizations produced resources in the past that were centred on the environmental issue or topic, rather than the curriculum—resources that were not as readily taken up by teachers. Elaine commented,

> The reason we wanted to go with designing materials for the curriculum is we've been doing environmental education for a long time and it was always a fight—oh here is this great climate change kit and you can fit it in here or fit it in there. So you are always coming from your subject matter and then trying to fit it into the curriculum. So we said, 'well, what are the main things that teachers need'. They have to meet their curriculum expectations. So if we provide stuff that will help them meet their curriculum and we infuse the green content, I think we have a better chance of meeting a broader base of teachers instead of just the real keen teachers that have that interest already.

However, this poses a bit of a difficulty in that the Alberta elementary science curriculum does not have a notably strong environmental focus. Consequently, the resource producers work on a 'best fit' scenario. Deven and Elaine's NGO has focused on energy

and the Grade 5 Electricity units. This is in keeping with the central tenets of the organization and the predominant economic mainstay of Alberta, fossil fuel-based energy production. Brian's organization focuses on energy (including electricity and oil sands development), forestry, and wetlands—Grade 5 and 6 topics in the elementary science curriculum. They endeavour to incorporate topical environmental issues within their resources, such as the plight of woodland caribou within the forestry resource. There is also an effort made to integrate social studies curricular outcomes with the science. The government resources touch on a broader range of topics including waste management, forestry, petroleum, endangered Alberta species, wetlands and water. However, the links to the elementary curriculum are not as clearly delineated. Without a strong environmental component in the elementary science curriculum, environmental education becomes a bit of a piecemeal undertaking. The government and NGO representatives recognize this difficulty. Amy commented,

> There is a push to—especially given that the environment is the number three priority that Albertan's have identified—to do more with integrating environment *across* the curriculum. So math, they have some requirements to teach math, exponents and fractions and blah, blah, blah. Why not use environmental examples to teach those concepts.

However, given the existing elementary curriculum in Alberta, environmental education does not really have a central focus and is still subsumed primarily within science instruction. This is evident in the resources produced by the various subcommunities. With few exceptions, the resources are targeted toward the science curriculum units and topics of study. Alberta's new social studies curriculum contains a much stronger focus

on environment. Perhaps the emphasis needs to shift to curricular integration as Amy suggested; move away from science as the primary target for environmental education.

Corporate Involvement in Environmental Science Education

Questions emerge around the impact of corporate sponsorship in terms of resource production and teacher professional development. Corporate involvement focuses primarily on funding or sponsorship and, to a lesser extent, partnership. In some instances, a partnership is formed whereby all parties are involved in some way in resource production or teacher professional development other than solely through funding. For example, some reciprocal relationships form around resource writing, review or marketing, or through linking to others' resources on web sites. Most often however, corporate involvement centres on monetary sponsorship.

Brian, Gwen, and Elaine maintained that the corporate sponsorship did not impact the direction of their resources or programs; industry did not put any undo pressure on them to carry particular messages. When asked if she felt corporate sponsorship had any impact on her work, Elaine replied, "No, no." Similarly, Gwen stated, "No. We do what our mandate is" when asked the same question. In the rare instance where a corporation did push for a particular viewpoint, both Brian and Elaine indicated their organizations would say no. Elaine said, "it has to say this or you can't say it—there's none of that. ... We would just say no." Brian commented,

> We don't hide it [corporate sponsorship] but there are opportunities for us to walk away if there are organizations that don't share our view or that don't want to support our programming. That's why we don't get an oil and gas company coming to us and say, 'can you develop me an educational resource that I can put

> in the schools to tell them how wonderful we are?' 'No. You can hire a writer to do that. Go hire a retired teacher; they'll do that and you can make it say whatever you want.'

Deven also indicated she did not believe corporations had any significant impact on the direction of her work, that they were more interested in "numbers," that is, how many teachers were accessing the resources, and so on. However, she did suggest one instance where a sponsor questioned the content of a resource:

> There was a non-renewable energy plant like an electrical plant and when you clicked on it the smokestack was really black and red and they didn't like that. We kept it dark but it was toned down a little bit. That was the one thing that I remember that was sort of on the political side. The rest of it has been more scientific items.

The only participant who admitted to a possible corporate impact on the direction of her work was Fiona. When asked if she felt corporate sponsorship impacted the direction of her work, she replied, "I don't think it can't. I think it certainly comes into play." But she stated that she relied on the curriculum as well as standards and guidelines to "back" her up in her work.

At a different point in the conversation, I asked Brian if any of their sponsors had particular interests they wanted conveyed in a resource. He indicated that they do make their interests known but he felt this contributes to the balance of a piece. Regarding corporations' willingness to include their position alongside a possibly opposing perspective, Brian said, "[If industry] funded a project that said bad things about what [they] do ... that speaks to me to be more altruistic then putting out a glossy PR piece ...

it's a balanced piece in there." Juxtaposed with what he said moments later in the interview,

> Industry in Alberta talk a lot about social license to operate ... tacit permission for doing what they do that tends to be extractive in nature ... getting permission from the people because [they're] doing good things, doing the right thing for the right reason. ... Balanced education is about doing the right thing for the right reason.

I cannot help but wonder if corporations have not found themselves an even better 'PR' piece. Brian pointed out that, for the most part, sponsors want to have their name associated with the NGO—it is, after all, a "saleable item."

The government subcommunity is in a different position from the NGOs; they do not directly receive corporate sponsorship. However, within government there is a particular political stance. When I asked Amy who had final say for the end product, she replied, "there is occasion where we've had stuff pulled back because they [communications department] want messaging changed or messaging added that just talks about the government direction more clearly." And later in the conversation regarding bias-balance, Amy stated,

> Well, *that* [giving a range of views] can be challenging inside of government. ... It depends on the topic area. How do you enable yourself to do that while there are things that government is working to promote? ... There's a whole big debate on climate change and Alberta's position is different from the federal position and how do you present that to people. It's challenging, but fun.

The interviews with the participants indicate corporate involvement in environmental science education does impact the direction of their work to some extent; perhaps subtly. The degree to which corporations influence the content of environmental science resources can only be ascertained through a critical examination of the resources themselves.

Overall, the data indicate these education subcommunities, the provincial government and nongovernmental organizations, view their role as necessary, fulfilling a need for instructional resources and teacher professional development. The perspectives the participants hold regarding nature and our relationship with nature, as well as their notions around certainty, multiple perspectives or 'bias-balance', and ecological literacy, act to shape the resources they produce. The findings also indicate that curriculum is central to resource production and must be considered first rather than environmental concepts and issues; this speaks to the need for a cross-curricular approach to environmental education. And lastly, it would appear that corporations, whether acknowledged by the resource producers or not, have a definite impact on resource production. In the next and final chapter, I turn to a further exploration and discussion of these findings, as well as the findings from Chapters 4 and 5, the critical discourse analysis of the instructional resources.

CHAPTER 7: DISCUSSION

The Shadow of the Bear (2006), by Brian Payton, is a book about Earth's last remaining species of bears and the challenges they face surviving in today's fragmented world. It is also about the author's experiences and thoughts as he travels the world over in search of a connection with these amazing and often rare and elusive creatures. This book is not part of my analysis—I have stolen moments away from my work to read it for personal fulfilment. But I mention this book because it resonates so strongly with me. Payton's words remind me of why this small piece of research matters—why I am doing what I do. In the introduction of his book, Payton says,

> It seems to me that one could probably tell a lot about a society by the way it treats its bears. ... People and bears compete for shrinking space and resources. From the beginning, bears and other large predators have shaped our development by forcing us to cooperate for the protection of each other's lives and, eventually, livestock. Now we shape theirs. (p. 8)

He goes on to say,

> Six of the eight bear species are on the [IUCN Red List of Threatened Species]. ... Saving them will require an enormous test of our ability to cooperate; failing—at the very least—will mean the irretrievable loss of a way to understand ourselves. (p. 8)

The future survival of bears and of myriad Others, and our own future as human beings is what is at stake. I believe "our ability to cooperate" and to effect change is dependent upon humankind developing a shared environmental consciousness. We need to understand our interconnected and interdependent relationship with Earth's systems, as

well as our power to disrupt those systems. We need to recognise that we cannot continue our current consumption patterns and 'growth' ideology. We need to be aware of our shared responsibility and be able to critically and thoughtfully act upon that responsibility—we need to be ecologically literate. My research touches upon a piece of this discourse, endeavouring to raise questions and awareness of the ecological and science discourses that are part of environmental science resources produced for the elementary classroom; discourses that play a central role in ecological literacy and act to shape environmental consciousness and identity. The subcommunities involved in resource production are varied—I believe we need to be cognizant of their place as participants in these discourses. It is also important to be attentive to the context of production, including a critical awareness of the role of corporations in educational resource production.

The discussion of my research findings begins with an examination of the ecological and science discourses as they are constructed by the view of nature and human-nature relationship, and the notions of uncertainty and multiple perspectives. These discourses are central to and interwoven with ecological identity and literacy. I conclude this section with an exploration of the three dimensions of ecological literacy, specifically their inclusion in the resource materials and relationship with the elementary curriculum. I then turn to a discussion of environmental education in Alberta, examining the context of production of the environmental science resources, followed by a critical appraisal of corporate involvement in resource production. Finally, the implications for both theory and practice are considered, and avenues for further research are explored.

Ecological and Science Discourses

Dryzek (2005) describes discourse as "a shared way of apprehending the world" (p. 9). As social beings, we inter-actively use the tools of discourse, language being but one of them, to make meaning and to construct our world. In turn, as participants in various discourses, our shared understandings and perspectives are dynamically shaped by these discourses; shaped through the use of language and other symbol systems. Gee (2006) suggests, "language-in-use is a tool, used alongside other tools, to design or build ... seven areas of 'reality'" (p. 11). He describes the "'seven building tasks' of language" as: significance (to give things value), activities (to enact), identities (to construct an identity or role), relationships (building social relationships), politics (perspectives on social commodities), connections (or relevance), and sign systems and knowledge ("to make certain sign systems and certain forms of knowledge and belief relevant or privileged, or not") (p. 13).

Similarly, Halliday (1998; 2004) contends language, specifically grammar, enacts interpersonal or orientational relationships, and through its ideational or presentational metafunction, transforms our experiences into meaning. Halliday (1998) states,

> the grammar [of natural language] construes a universe of things and relations, imposing categories on our perceptions of phenomena; in other words, it sets up a theory of experience, modelling the immensely complex interaction between the human organism and its environment. (p. 187)

The language of science is not natural, everyday language. It employs specialised vocabulary and, more importantly, grammatical patterns (e.g. nominalization), which [re]construe aspects of human experience. The language of science is not just another

way to say the same everyday things, but rather re-constructs knowledge, and is therefore, a distinct ideology.

> Ideationally, the nominalising grammar [of the language of science] creates a universe of things, bounded, stable and determinate; and (in place of processes) of relations between the things. Interpersonally, it sets itself apart as a discourse of the expert, readily becoming a language of control. In both aspects, it creates maximum distance between technical scientific knowledge and the experience of daily life. (Halliday, 1998, p. 228)

The language patterns and images incorporated in the environmental science resources construct particular discourses. The grammatical patterns and root metaphors of the texts act to re-construe human experience and relationships, including our relationship with nature. Through their interaction with this written or visual text, children may consciously or unconsciously assimilate the messages and companion meanings embedded within the text, becoming participants in particular, socially constructed ecological and science discourses. The document and interview analyses focus on how text, written and visual language, acts to re-construct 'reality'.

View of Nature and Human-Nature Relationships

Other relevant studies have examined the language and visual images of textual resources to explore the discourses surrounding science, nature and the human-nature relationship (cf. Korfiatis, Stamou, & Paraskevopoulos, 2003; Östman, 1994, 1996; Veel, 1998). Östman's work centres on secondary science textbooks, specifically chemistry texts, suggesting school science discourse can shape a particular view of nature and the human-nature relationship. My analyses of the environmental science texts and

interviews pertaining to the view of nature and human-nature relationship draw on and extend Östman's work.

Veel (1998) examined a variety of science-based resources, from elementary to secondary; student writing to classroom science (ecology) text. His study examined human-nature relationships as a context for exploring the language of science and the language of environmentalism; specifically, how these discourses are different and how those differences are expressed through grammar and visual text. Veel suggests the language of environmentalism encompasses both a scientific (ecology) body of knowledge and humanities-based concepts (social, political, and economic). The combination of these diverse discourses renders the language of environmentalism distinct. Veel found that school texts which incorporate environmentalist ideas are discursively mixed; a blend of environmentalist and scientific discourses. The text genres are blended; a combination of expository and informational or report-based generic structures. I found a similar blending of discourses, particularly in the forest resources *Between the Stands* and *Envriokids*, and to a lesser extent in the electricity resources *Science 5* and *Electricity*. In part this is not surprising, given that these resources are intended for elementary education, which tends to be more cross-disciplinary in its approach, and include social as well as science objectives.[13] As well, there is a personal, emotive element included in these texts, reflective of environmentalist discourse, but also often employed in texts intended for younger audiences. Metaphor is used rhetorically to "engage the emotions of the audience" (Bell, 2005, p. 58), such as the use of

[13] The *Science 5* resource does not include stated social studies outcomes because it is intended as an instructional resource for Grade 5 science. However, the resource does address environmental issues and concerns from a social perspective, and, consequently, presents a blend of environmentalist and science discourses.

"environmental nasties!" in the *Science 5* text (Activity E4: EnerGuide Investigation). Kress and van Leeuwen (2006) found school texts for younger children included more 'demand' images, construing emotive involvement. These types of images were used progressively less often in texts intended for more mature learners. They suggest this was the case because "objective knowledge had to be built, apparently, upon a foundation of emotive involvement. ... This foundation was then, gradually, repressed, for if it was not repressed, the knowledge built upon it could not be seen to be objective" (p. 121). The *Energy Literacy Series*, intended primarily for older students, exemplifies the objective, non-emotive school text; there are no 'demand' images and the text rarely addresses the student personally. And yet, personal involvement and connection are essential for critical decision-making and action concerning ecosocial issues, rendering the 'objective' approach problematic.

The *Energy Literacy Series* and the school district text, *Trees and Forests*, contain predominantly science discourses—an 'objective' and non-emotive approach—but the language of 'objective' and 'value-neutral' science, which I would argue is neither objective nor value-neutral, constructs "an ideology of power and dominion over nature" (Aikenhead, 2006, p. 387). Particularly in the examples of the school district text and the *Energy Literacy Series*, the discourse about nature is construed through a human-centric perspective that values nature in terms of its usefulness as a resource for human beings. In this respect, my findings regarding these two textual examples correspond to the findings of Korfiatis et al. (2003) in their survey of Greek primary school textbooks.

The human-centric view of nature as a resource or commodity for human use and consumption was also evident in the interview data. Brian viewed the environment and

natural resources as two separate entities, implicitly disregarding the complex relationship between the two; and the importance of resource management was emphasised by Fiona and Amy. The metaphorical language of management and natural resources can be problematic. These conceptual metaphors shape our values and understanding of nature and the environment within an economic context (Bell, 2005). The 'management' metaphor suggests control or mastery over nature; an interconnected relationship is absent. However, there is a sense of maintaining or conserving nature, ostensibly for future human use. But Bell argues, "nature is not passive and manageable but active, responsive and too complex to be predicted" (p. 62). Further, Sauvé (2002) critiques this notion of management; she suggests, "it is not, in fact, a question of managing the environment but of 'managing' our own choices and behaviours in relation to it" (The conceptual issue of EE, para. 7). The 'nature as a resource' metaphor implies nature is there for humans to use; it does not suggest conceptions of connection or preservation (Bell). Drawing on Gee's (2006) framework, the "building task" of this use of metaphorical language is political, constructing a particular perspective of nature as a social commodity. It is important to recognise and be aware of the power of language to construct a particular discourse about nature and science.

Notion of Uncertainty

Östman (1994, 1996, 1998) recognizes the power of language and discourse, especially in the school classroom setting. He maintains science classroom discourses and the language and images of school science texts carry companion meanings, meanings that act to shape a particular view of nature and the human-nature relationship. Typically, school science centres on accepted, consensual science or 'ready-made-science' (Bingle

& Gaskell, 1994) and is characteristically perceived as factual—the truth. Feyerabend (1993) also talks about the simplification of science in schools, its separation from history, and the consequences of such a separation—"stable 'facts' arise and persevere despite the vicissitudes of history" (p. 11)—the nature and history of science with its inherent uncertainty is all too often distanced from school science. This notion carries the implication that what is being said (or *not* said) regarding the environment within a school science context is also the truth and, perhaps, not contestable. And if the educational resources centre on, as Fiona said, "bring[ing] in so much of the talking about industry, the role of industry, about the role of government in managing the land," then this view of the environment and the human-nature relationship becomes the 'correct' view—the truth. Beder (2002) is concerned about this notion of 'truth' in classrooms pertaining to the inclusion of industry perspectives. She states, "Unfortunately children are usually not able to discriminate between genuine education and the manipulative messages of corporations. Many assume that what they are taught in the classroom must be the truth" (p. 173).

Environmental issues are complex and are often characterised by uncertainty, especially over the long term (Foster, 2003). Interestingly, several of the interviewees commented on the importance of being certain; being "factually accurate" and getting the "numbers right," even within climate change education, a controversial ecosocial issue. This interest in 'facts' is evident in the instructional resources; the language is predominantly certain, conveying 'truths' and consequent 'authority', or at least the perception of authority. Presenting science as objective truths is a positivist view of science, a view of science that is generally regarded as untenable as it ignores contextual

social factors (Bingle & Gaskell, 1994; Foster, 2003). Further, Lemke (1995) suggests, "we moderns believe that matters of fact, or truth, *ought* to take precedence over matters of other, equally fundamental values, such as goodness or desirability" (p. 147). This notion is especially relevant when considering environmental issues and decisions regarding these often uncertain, value-laden and controversial issues. As Bingle and Gaskell state, "scientific knowledge relevant to a real socioscientific dispute could be construed as affected by contextual values, and that this process might influence a citizen's evaluation of those knowledge claims" (p. 195). The resources' emphasis on 'facts' and certainty does not exemplify the socially contingent nature of science and scientific knowledge (Foster), generally overlooking the moral and ethical dimensions inherent in controversial socioscientific issues (Sadler, Chambers, & Zeidler, 2004). Generally, the resources construct a science discourse reflective of a positivist perspective rather than a social constructivist view of science. In this way, science becomes a part of the 'cultural filter' for a Western perception of nature and the environment (D. Pepper, 1996). However, this is countered to varying degrees by the inclusion of ecological discourses—discourses that incorporate contextual social factors and diverse perspectives.

Multiple Perspectives / 'Bias-Balance'

Several of the resource producers stressed the importance of including multiple perspectives, or producing 'bias-balanced' materials, especially the NGO that produces the instructional resources, *Between the Stands* and *Electricity*. The producers maintain they are representing the views of industry alongside others' perspectives in an impartial and equivalent manner; they contend their materials are 'bias-balanced.' However, I

question whether bias-balance is even possible or whether it is in actuality a myth. Multiple perspectives may be evident but what is emphasised? Haury (2005) states, "any book, article, essay, video, or multimedia production that addresses an environmental issue, problem or concern reflects a point of view—the perspective of the author(s), or producers of the resource material" (p. 185-186). Further, he suggests "this is natural, and to be expected" (p. 186) and that it is essentially up to teachers to be aware of these biases. However, if the producers emphatically claim their materials are bias-balanced, perhaps teachers, especially inexperienced teachers, may be unaware of biases present in the materials they bring to their students; they may trust in the authority of the producer and their resources. Fiona, one of the writers of resource materials, commented,

> Between textbooks and some of the other resources that are out there, there's a pretty good kind of 'this is the way it is, this is the science type.' There's a good range of those ones. There's not a lot that try and bring in multiple perspectives. Our teachers respect that they can pull one of our resources off the shelf and hopefully get those multiple perspectives right there, ready to go.

Her view of science aside, Fiona positions her organization's instructional resources as 'Monday-morning-classroom-ready' materials that contain essentially all of the perspectives around a particular topic or issue (i.e. that the resource is authoritative). Her statement also implies her organization's resource materials have an advantage over other resources through the inclusion of multiple perspectives. Perhaps then, bias-balance, or the perception (i.e. label) of bias-balance, is in actuality a tool for resource marketing.

While the producers may honestly believe their resources are bias-balanced and present multiple perspectives, the language and visual images of the texts construct

particular perspectives and discourses, oftentimes subtly embedded in the grammatical features of the text. For example, textual features as simple as typography (use of bold, italics, font style) or compositional placement, give particular pieces greater or lesser emphasis. As well, what is *not* said, what is omitted, also presents a particular bias. Apple (2000) would argue that texts are never neutral. They are "authored by real people with real interests. They are published within the political constraints of markets, resources, and power" (p. 44). The educational resources produced by the various subcommunities are produced from within the political and cultural context of Alberta—a politically conservative province with strong ties to the oil and gas and forestry industries. Additionally, the emphasis and inclusion of a bias-balanced approach in educational resource production is possibly more reflective of funding requirements (see Deven's comments p. 131) rather than any pedagogical or ethical concerns, again raising questions around the notion of bias-balance. As Deven said, "it puts the red flags up."

Perhaps the shifting and somewhat fragmented views of nature and the human-nature relationship, evident particularly in the *Between the Stands* resource, reflect this emphasis on bias-balance and are dialogically relational to the context of production, that is, the history, politics and culture of Alberta. Surveying the headings across the student text (banner), this resource does present a reasonably broad range of perspectives. However, as previously discussed in the findings, the typography of the text and its organizational structure lend emphasis and importance to certain pieces over others. It is also important to remember that companion meanings are also constructed by what is *not* said. For example, this resource does not discuss issues surrounding harvesting practices or the harvesting of old-growth forests. The inclusion and exclusion of particular

perspectives or viewpoints act to construct particular discourses; the question is *whose* discourses?

And finally, there is another issue for consideration which raises questions around the desirability of advancing bias-balanced resources. By giving equal weight to different perspectives it suggests that each position is equally valid, even if scientific evidence or social mores may suggest otherwise. In a recent interview (Cernetig, 2007), David Suzuki raised this issue of balance. "In the name of balance," he argued, the media in the 1990s presented competing scientific opinions regarding global warming, even though the majority of scientists were in agreement. Suzuki suggests this led to confusion for the public and the belief that, since scientists were still debating the issue, it was not something to be concerned about. The consequence of this, he suggests, was a preventable and potentially disastrous delay in addressing climate change issues. Similarly, one of the interview participants, Deven, questioned the notion of bias-balance, implying that environmental educational resource producers should be more forthright and open about possible biases. She stated, "I think if we are going to be biased then we state that bias. ... You may actually write a piece that is *not* bias-balanced. It may actually be very much geared towards the environmental objectives." Understandably, this raises concerns around advocacy in environmental education (cf. Jickling, 2003; Johnson & Mappin, 2005), but also suggests that educational and curricular decisions need to be made around what ecological and scientific discourses we want our students to participate in.

Dimensions of Ecological Literacy

Thus far, this discussion has centred on ecological and scientific discourses and how these discourses pertain to and are constructed by the view of nature and human-nature relationships, and by the notions of uncertainty and multiple perspectives. These discourses, notions and perspectives are interwoven with ecological identity and literacy, which is central to my research. A number of the resource producers/writers seem to have an intuitive understanding of the three dimensions of ecological literacy—functional, cultural, and critical—but the resources do not reflect this awareness. The resources focus very heavily on functional literacy—on informational knowledge. Cultural literacy is only hinted at, and, depending on the resource, the critical decision-making or action components are only perfunctorily mentioned, not deeply critical, or limited in personal student involvement. The *Energy Literacy Series* is a notable example.

Of particular interest is the word 'literacy' in the title of the *Energy Literacy Series* resource—what does it mean to be 'energy literate'? This resource concentrates on providing information and foundational knowledge about the different forms of energy, and energy technology and production. For each of the ten modules, four of the five organizing sections focus on scientific, technical and factual information. The fifth section addresses issues and concerns, but again, primarily in an informational, report-based manner. Culture, values, and critical decision-making and action are given short shrift. Literacy, in the sense construed by this resource, means knowledge *about*—it is predominantly functional literacy and not multidimensional. This approach and emphasis on functional literacy, which fails to effectively link scientific and ecological knowledge

with environmental issues, is not adequate for the development of a scientifically or ecologically literate society as a whole (Slingsby & Barker, 2005).

The emphasis on foundational knowledge or functional literacy is not surprising given that these resources were developed primarily for the Alberta science curriculum and within a culture of accountability in the province. As previously discussed, school science often fails to include the cultural, political and historical aspects of science. This is especially true of the Alberta Elementary Science (Alberta Learning, 1996) program of studies; cultural ecological values are virtually non-existent.[14] As well, environmental learning objectives, including issues-based critical decision-making and action components, are limited. However, the curriculum rationale does include the notion of responsibility, citizen action and critical decision-making:

> Tomorrow's citizens will live in a changing environment in which increasingly complex questions and issues will need to be addressed. The decisions and actions of future citizens need to be based on an awareness and understanding of their world and on the ability to ask relevant questions, seek answers, define problems and find solutions. (Alberta Learning, p. A.1)

But, the specific learning objectives focus on students 'recognizing' and 'identifying' actions. For example, "recognize human responsibilities for maintaining clean supplies of water, and identify actions that are taken to ensure that water supplies are safe" (Alberta Learning, p. B.8); or, "recognize that human actions can affect climate, and identify

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[14] Valuing living things (nature) is explicitly mentioned twice: 1) Grade 1: "Identify ways in which living things are valued; e.g., as part of a community of living things; as sources of food, clothing or shelter" (Alberta Learning, 1996, p. B.5); and, 2) Grade 6: "Identify reasons why trees and forests are valued. Students meeting this expectation should be aware that forests serve as habitat for a variety of living things and are important to human needs for recreation, for raw materials and for a life-supporting environment" (p. B.33). It is implied in the following Attitude statement (included for each Grade level): "respect for living things and environments, and commitment for their care."

human actions that have been linked to the greenhouse effect" (Alberta Learning, p. B. 27). Only one objective (Grade 4: Topic A: Waste and Our World) actually requires students to *do* something; to make decisions and to take some form of action—"Develop and implement a plan to reduce waste, and monitor what happens over a period of time" (Alberta Learning, p. B.19).

It is interesting that the resource producers have focused their attention on developing resources predominantly for the Alberta science curriculum, rather than the social studies curriculum. The Alberta Social Studies Kindergarten to Grade 12 (Alberta Education, 2005a) curriculum contains a much stronger emphasis on cultural values and political awareness, and includes learning outcomes aimed at developing an understanding of environmental issues, responsible citizenship, and sustainability. In conversation with the resource producers and writers, the topics or units of study mentioned in relation to their resource materials were all science topics, even though the majority of the resources include some social studies outcomes. This likely reflects the belief or notion that environmental education belongs within the purview of science instruction (Simmons, 1989); though one participant, Amy, recognized the shortcomings of focusing on the elementary science curriculum, suggesting curricular integration might be more apposite for environmental education. The focus on science curricular connections also reflects the general practice of environmental education which, as Sauvé (2002) states, "has been associated above all with the acquisition of knowledge *about* [italics added] the environment, giving very little room to the development of ethical and critical competencies" (p. 7). Knowledge about the environment is functional ecological literacy. Environmental education focused on the functional dimension is unbalanced and

presents an incoherent and incomplete view of the environment, isolated as it is from sociocultural and political contexts (Slingsby & Barker, 2005).

Though I consider the resources to be especially ineffectual in developing cultural ecological literacy, a few of the resources do include avenues for exploring critical literacy (especially *Between the Stands*, *Science 5*, and *Electricity*). But, as Stables (1998) maintains, critical ecological literacy, which is crucial for empowerment, action and change, is dependent on both functional *and* cultural literacies. Lemke (1995) states, "what we physically do depends on value choices and meaning choices. Those values and meanings are embodied in the texts, discourses, activities and artifacts of our culture, which we learn to use for ourselves as members of a community" (p. 101). If we expect our students to be active members of a community (local and global) and future decision-makers, how are we adequately preparing them to fulfil this expectation if they are not offered all the necessary opportunities and tools to do so; tools such as an awareness of the significance of our ecosocial relationships (which includes our relationships with the more-than-human), societal values, and an ability to ask critical questions about whose values are dominant? This is a serious failing.

Context of Production: Environmental Science Education in Alberta

Texts are not produced in isolation—they are constructed within a particular ecosocial, cultural and political context, and for a specific audience that is situated within a particular sociocultural context. Lemke (1998a) states,

> Verbal data, including particularly written or printed texts, always make sense in relation to a context of production, or the circumstances in which they were

written or spoken, and a context of use, or the circumstances in which they are read or heard. (p. 1178)

The environmental science texts included in this study have been produced in Alberta by subcommunities situated within this province. They have been produced with the education system in mind (i.e. the current curriculum, accountability practices, school structure, economic situation, available resources, etc.), and with a particular view of teachers and students (audience) in mind. The context of production also reflects current (and historical) provincial, national and global politics and dominant ideologies concerning the environment and environmental education. Environmental science texts both construct and reflect a culturally complex ecosocial system.

The role government and nongovernmental organization subcommunities play in environmental science education in Alberta is significant. These subcommunities produce a wide assortment of instructional resources that are, for the most part, available free of charge for the province's teachers. Teacher professional development and direct program delivery through classroom instruction or field trips are additional educational services provided by some of these organizations. These organizations view their place in the environmental/science education community as necessary, and in many ways it is. Alberta does not have a separate environmental education component in the elementary curriculum; this presumes environmental education is subsumed within the subject disciplines, typically science. And as discussed previously, Alberta does not have a strong environmental emphasis within its elementary science curriculum. As a consequence, many of the resources developed specifically for the curriculum do not adequately support environmental education and the development of ecological literacy (cf. *Trees*

and Forests, a science instruction text). Hence, teachers interested in environmental education need to look to sources beyond familiar science instructional materials, such as those produced by environmental subcommunities. Teachers may also turn to these often free resources to simply support science instruction, rather than because of any special interest in environmental education. Perhaps it is because the majority of these instructional resources are free that teachers are turning to them for use in their classrooms. Amy commented, "teachers really like the resources because they are free." She believed this reflected budgetary constraints, which "creates a barrier to access" for resource materials. Beder (2002) expresses concerns about the underfunding of education, suggesting corporations are taking advantage of the situation schools and teachers find themselves in when trying to access classroom resources. Whatever the reason, many teachers are accessing the instructional resources and professional development opportunities offered by these organizations, evidenced by the success, creation and expansion of NGOs in the environmental science education community in Alberta.

The changing role of these organizations in environmental education is worthy of note. There appears to be a recognition or perhaps perception that the word 'environmental' has a negative connotation. It has therefore become important to carefully choose 'appropriate' language when talking about environmental issues or education. In speaking of writing resources, Deven commented, "I think one thing I try to keep in mind is a positive language and using language that doesn't create eco-phobia or actually work *against* what you are trying to communicate." The careful choice of language in order to mitigate some of the perceived negative subtext associated with

environmentalism functions ideologically, contributing to the maintenance of hegemonic cultural relations of privilege and power (Lemke, 1995). Similarly, shifting the primary focus from environmental education to education concerned with science and development acts to 're-brand' environmental education; to shift the focus from the environment to natural resource management. As previously mentioned, when I asked Fiona if she would describe the NGO she works for as an environmental organization, she replied, "I wouldn't." She went on to say, "In the 90s I would have. ... We're natural resources education talking about the development, the issues, the science." This 're-branding' operates to ideologically realign environmentalism with management and industry perspectives and agendas. This discourse acts to shape a particular view of nature and human-nature relationship, contributing to what Sauvé (2002) suggests are "fundamental issues in the current crisis, namely the rupture between humans and nature" (p. 15).

Perhaps this 're-branding' or shift in focus is a strategic move on the part of NGOs to attract more corporate sponsorship. Or, perhaps it reflects the influence of corporations or a strategic move on their part as they move away from in-house resource production. Molnar (2005-2006) noticed a recent decrease in corporate involvement in schools, particularly concerning the marketing of non-nutritional foods and soft-drinks. However, he suggests, "there is limited evidence that a shift in public consciousness about commercialism is reshaping the way it manifests itself, and commercial interests are responding accordingly, finding ways to reframe their activities in light of such controversy" (p. ii). It is interesting that industries in Alberta have moved out of the resource production market, switching to a partnership model—partnering with NGOs to

produce educational resources. The NGOs are now producing resources that had formerly been produced by, for example, the forestry industry. It may be that industry is turning to the NGOs in recognition of their expertise in educational resource development, but this is also a subtle way to legitimize companies and their viewpoints. Any scepticism about a corporation disappears when they are connected with educational materials and their producers (Beder, 2002). The partnering of industry with educational NGOs, offers industry "the potential to shape environmental perceptions and improve corporate images" (Beder, p. 169), especially in light of the power of NGOs to indirectly influence policy through their educational activities and practices (Slingsby & Barker, 2005). Criticisms of corporate produced classroom resources have been levied in the past (cf. Gaskell, 1983; Knaus, 1992). By moving out of production to sponsorship, corporations can essentially 'hide' behind educational organizations, suggesting educators must not only be more cognizant of corporate involvement in the production of educational materials, but also ask critical questions about the possible consequences of such involvement.

Interestingly, Elaine and Brian both commented they believe teachers outside of the province of Alberta, particularly teachers in the provinces of British Columbia and, to some extent, Ontario, are more sceptical of instructional resources and professional development programs associated in any way with corporations. This reflects the particular cultural and political climate in Alberta. It speaks to teachers' beliefs and values regarding education. It speaks to the need for teachers to pay particular attention to the place in which they teach (Chambers, 1999; Sumara, Davis, & Laidlaw, 2001) and how the discourse of environmental education is shaped by this context.

Corporate Involvement in Education: Further questions and concerns

Corporate involvement in educational resource production is a growing trend (Beder, 2002; Molnar, 2002-2003). Molnar, in *No Child Left Unsold* (2002-2003), found a dramatic increase in corporate involvement in educational materials in the United States; "the 2002-03 report showed a four-fold increase in references to [corporate produced educational] materials – from 75 references in the 2001-02 report to 310 in the 2002-03 report – a 313% increase" (p. 31). Molnar reports a long-term increase of 850%, from 1990 to 2003. He suggests, "such materials may be thinly disguised advertising plugs for particular products, or may be subtly disguised propaganda for policy positions that serve corporate interests" (p. 31). Molnar's (2005-2006) most recent report *The Ninth Annual Report on Schoolhouse Commercialism Trends: 2005-2006*, finds the trend continuing; "Schoolhouse commercialism overall showed little sign of abating in the 2005-2006 school year. Practices that use schools as marketing agents for products and corporate ideology continue to proliferate" (p. 1).

The NGO forest resource, *Between the Stands*, is a relevant example of corporate partnership in the production of classroom materials. This resource is produced in partnership with industry (Alberta Forest Products Association[15]) and government (Alberta Environment). The question arises as to what, if any, corporate messages may be explicitly or implicitly embedded in the semiotic resources of the text. Veel (1998) suggests environmental science materials contain a blend of environmental and science discourses. In the resources produced in the context of increasing corporate involvement,

[15] "The Alberta Forest Products Association (AFPA) is a non-profit industry association that represents most of the companies that manufacture lumber, panelboard, pulp and paper, and secondary manufactured wood products in Alberta" (Alberta Forest Products Association (AFPA), n. d.).

I wonder, is there a corporate language beginning to creep in and blend with the languages of science and environmentalism?

More often than not corporate messages are subtle; at times subtle enough to go unnoticed by teachers (Beder, 2002). The NGO forest resource, *Between the Stands*, for example, explicitly acknowledges their resource production partners. The corporate logos for the developer (FEESA) and for each of the partners are prominently displayed on the lower, right-hand corner of the poster front; contact information is included with the student text (banner). Bordering the logos is a representation of a pine marten. The image is compositionally (organizationally) one of the most salient images on the poster and certainly the most salient item in that quadrant of the poster; the viewer's eye is drawn to marten and the logos. However, the presence of a corporate logo on educational materials insinuates an implicit message—that is the understandings and values students may construct as they interact with the text are consonant with corporate views. Because the NGO resource presents a responsible attitude towards nature, the underlying assumption may be that forestry companies do as well. While I am not trying to suggest that forestry companies act irresponsibly with respect to the environment, the difficulty lies in that children may become unwitting participants in a discourse that accepts the views of industry uncritically; without question.

Corporate involvement in the production of these resources, whether in the form of sponsorship or partnership, raises concerns regarding embedded corporate messaging and possible corporatist agendas. Questions regarding whose interests are being served need to be asked. Whose vision ultimately shapes the instructional materials? For

example, the following text on the Centre for Energy's website (co-producer of *The Energy Literacy Series*) describes their role in educational resource production:

> The Centre for Energy offers fact-based educational materials that make the oil and gas industry come alive in the classroom, interactive energy programs and a number of FREE publications for teachers, students and others interested in learning about Canada's energy industry. (Centre for Energy)

It would seem rather obvious whose interests are paramount, and yet the producers claim their materials contain "bias-balanced social and environmental content" (SEEDS Foundation). Their resources may indeed be useful for classroom teachers, but it is important to see them clearly for what they are and what they explicitly and implicitly say; what discourses they are a part of.

Final Thoughts

As an overarching framework, I have situated my research within ecosocial theory, and, more specifically, within discourse and critical theories as these inform ecosocial theory. My research—an exploration of the discourses of environmental science resources and the subcommunities involved in the production of these resources—perhaps raises more questions than it answers, but that is, at least in part, the role of critical theory and, ultimately, critical praxis. Lemke (1995) states,

> *critical praxis* is a shorthand way of saying that we need to examine ourselves, examine our own actions, beliefs and values to see how they connect to the larger patterns and processes of the system of which we are part, to understand how we are part of the problem in order to have any hope of becoming part of the solution. (p. 131)

Praxis is understood in relation to theory, and consequently, suggests that our actions—our practices—should inform and lead to changes in theories about our place and role in the world, just as theory can lead to changes in practices and actions (Lemke). My research has led to questions around ecological identity and our relationship with our environment and how this identity/relationship is shaped by the discourses of environmental science subcommunities and the instructional resources they produce for the elementary classroom. If educators hope to be "part of the solution" we need to recognise how our current practices can perhaps be better understood if viewed through an ecosocial perspective—a perspective that does not ignore our interconnected, complex relationship with the physical as well as social semiotic world. Similarly, an understanding of the discursive formations of environmental science communities and their complexly interwoven contextual, political, social, material, and historical situatedness can lead to a deeper understanding of ecosocial theory.

Implications for Theory

Ecosocial theory recognises human society as a dynamic complex system that is reciprocally linked with the material, physical world through our sociocultural practices—our practices affect and transform the physical world just as our being in the physical world shapes our systems and patterns of semiotic practices (Lemke). Payton (2006) expresses this awareness, suggested in the quotes from his book at the beginning of this chapter. Our relationship with bears has been shaped by our historical interactions with them. We once feared and revered the power of bears, but as our power has grown we no longer do so, often seeing them in terms of conflict with our human material desires. Now we shape their physical world, threatening their very

existence. This is but one simple example among a myriad of others, which illustrates how human sociocultural practices and meaning-making are dialogically, historically and ecophysically situated. The environmental science resources and the processes behind their production are also examples of historically and ecophysically situated sociocultural semiotic practices. The cultural, political, historical and ecophysical context, a predominantly Western context, has shaped the view of nature, science, and our relationship with nature constructed by the resources. Lemke (1995) suggests, "we are partly blinded by the biases of the dominant class in Western society, whose interests favor a view of the world as indefinitely exploitable materially and indefinitely flexible culturally" (p. 108). The discourse analysis of the documents and interviews through a critical and ecosocial perspective helps me to see, to not be blind. An ecosocial theory helps me to conceptualize the environment as text, as a semiotic sign system and knowledge that Western society does not happen to privilege (Gee, 2006). An ecosocial theory also has implications for ecological literacy endeavours, framing praxis. This awareness or understanding is reciprocal, informing a deeper conceptualization of ecosocial theory.

Implications for Practice

Hart (2003) suggests, middle childhood is extremely important in the construction of environmental and social consciousness, what Thomashow (1995) describes as ecological identity; it is therefore crucial that teachers are aware of the ecological and science discourses of classroom resources that may play a role in shaping that identity. I believe this is particularly important in light of the increasing involvement of corporations in educational resource production.

In speaking with the producers and writers of environmental science resources for use in the elementary classroom, questions emerged regarding the production of these resources. The subcommunities comprising the science/environmental education field, intentionally or not, influence understanding, moral responsibility and individual action. Corporations play a huge role in resource production, particularly in terms of monetary sponsorship for the NGOs, though the provincial government is not without its own "corporate messaging." Educators must be aware of stakeholders' agendas, and their subtle (and oftentimes not-so-subtle) influences within curriculum. Teachers need to be aware of the discourses of these resources and of the messages they may unknowingly be bringing into their classrooms. It is therefore important for teachers to approach instructional resources with a critical eye—to critically examine and be aware of underlying meanings, social stances, hegemonic ideologies and possible corporatist agendas embedded in environmental science resources—curricular resources that effectively act to carry forth and shape our students' identities, views of nature and the environment, and social practices.

It is also important for educators to be aware of how the teaching and learning of science, directly or indirectly, plays a significant role in the development of student attitudes towards nature, environmental responsibility and consciousness. The language of school science can effectively distance students from an awareness or understanding of the interconnectedness of Earth's systems, particularly as regards human values, interaction and agency. Lemke (1995) suggests, "a discourse, a way of speaking, is considered less scientific, or even rendered 'unscientific' exactly to the extent that it includes elements either of the language of feeling or of the language of action and values" (p. 178). Thus, school science discourses, in order to be perceived as scientific,

necessarily remove language related to values and action. And yet, values and critical action are essential to ecological literacy. This is an especially important notion since environmental education is most often subsumed within the subject matter and teaching of science. Perhaps then, we need to regard environmental science education differently; Dillon (2002) suggests a possible

> shift from seeing 'environment' as a focus for consideration of science concepts to seeing a science education as one that, properly, seeks to help students understand environmental issues in the context of their lives, and their lives in the context of environmental issues. Our identities are only artificially separated from our environment. (p. 1112)

Or perhaps, as Bonnett (1997), Orr (1992), Stables (1996; 2001) and others argue, environmental education should not be relegated to one subject area; rather, environmental education, beyond even a cross-disciplinary approach, should be reconceptualised as "within-disciplinary" (Stables, 2001). Elementary educators perhaps have a distinct advantage in this regard as they generally teach their students all the subject areas. However, teachers still need curricular and resource support to be able to fully integrate environmental education within the disciplines. This kind of support is vital if we are to help our students become ecologically literate citizens. It is also crucial that educators, including pre-service educators, curriculum and resource developers, recognise that while school may only form a small part of children's education on their path to adulthood, it "set[s] [them] on certain paths rather than others, paths that foreclose many possible alternative trajectories of development in [their] patterns of beliefs, values and actions" (Lemke, 1995, p. 141). We must ask ourselves, what are the patterns

constructed by the discourses of environmental science classroom resources? What do we want those patterns to be? Who decides? As Lemke poignantly states,

> [A] postmodern critique of the fundamental assumptions of the dominant subculture ... will help us to redress further the imbalance of power ... and help us re-envision the relations between human interests and the larger interests of the ecosystems of which we are integral parts. (p. 4).

I believe it is vital that we re-envision education in a way that honours the more-than-human and our interconnected and dynamic relationship with nature. By doing so we open up further possibilities for "way[s] to understand ourselves" (Payton, 2006, p. 8) and our place in this world; we open up avenues for hope.

Further Research: Possibilities and Wonderings

My research seems to me only a beginning—there is so much to explore if the kind of environmental science education I envision is to ever become a reality in the elementary classroom. A critical examination of the ecological and scientific discourses of classroom materials allows for an initial understanding and awareness of the potential meanings teachers and children may construct as they interact with the text. However, it seems a commonsense step to explore the actual use of and interaction with these texts in the classroom; to talk to teachers and observe their use of these texts as instructional resources; and to talk to children to try to understand the meanings they socially and personally construct as they interact with the texts, their teacher and their classmates. I have so many questions I would like to ask; so many avenues for research I would like to explore. What educational and environmental values do the teachers who choose resources such as those I have examined hold? How do teachers mediate the messages

embedded in the instructional resources? Are they cognisant of implicit messages or of the context of production and involvement of corporations? Does that concern them? Why or why not? And the children—what are their prior experiences and relationships with the natural world? How might this impact their interaction with environmental science texts? How do the textual resources shape children's relationship with and view of nature and their developing ecological literacy? And curriculum? How does curriculum impact ecological literacy development?

These and other questions lead me to wonder about the importance of place and personal, physical interaction with the natural world. How important is this to developing an ecological identity and environmental consciousness? Can the online resources (with their images of natural spaces) offer an alternative way for students to engage with the environment? As a child, I had myriad opportunities to interact with the more-than-human, but what of today's children? How many of them have similar opportunities? In what ways might this affect the children? I would like the opportunity to explore these and many other questions within an ecosocial theoretical framework, which I believe has the potential to help further understanding and, reciprocally, inform ecosocial theory. The possibilities and opportunities stretch out before me.

AFTERWORD

A Changing Context

Since I began my research, spring 2006, the political and social context in Alberta and in Canada concerning the environment and environmental issues has changed. My evidence is anecdotal—I have been clipping out newspaper articles related to environmental issues, especially climate change, from my local paper for about four years. At first, I clipped perhaps an article or two a week, mostly small articles buried deep in the paper. Recently the number of articles has dramatically increased—articles appear daily. Additionally, articles have appeared in more and more sections of the paper—the front page, top copy, editorial, business, politics, letters to the editor, life, ideas, editorial cartoons, and even the comics. I attribute the change to an expanding public awareness and concern about environmental issues, particularly climate change. I believe the impetus for this relatively new change in awareness and concern and consequent media attention stems, at least in part, from two recent events—the release of the Intergovernmental Panel on Climate Change (IPCC) (2007) report on climate change *Working Group I Report: The physical science basis*, and Al Gore's documentary *An Inconvenient Truth* (David, Bender, & Burns, 2006). As a consequence, the Alberta provincial and Canadian federal conservative governments have been pressured through public opinion and political will to act on climate change issues. The debate continues as to what form that action might take, but there is considerable debate and pressure. However, it appears the Canadian government will not honour Canada's commitment to the Kyoto accord, and will set intensity-based targets for greenhouse gas emissions—targets not deemed stringent enough by many environmental groups (cf. The Pembina

Institute, 2007). Alberta seems to be leading the way on the decision to implement intensity-based targets, proposing a provincial climate change plan based on this system of controls for greenhouse gas emissions (see Alberta Environment, 2007).

It will be very interesting to follow the climate change debate and political process, particularly in light of the swelling 'green' consciousness that seems to be arising. I wonder if this is a sign of dramatic change to come; of a [r]evolution in terms of our relationship with the environment. Or is it the current political and social 'flavour-of-the-month' which will fade in due time? Alberta is a province experiencing a staggering economic boom—the money is flowing almost as freely as the oil. And, in times of economic prosperity, we perhaps are more willing to give environmental concerns our attention. But what will happen in times of economic downturn and recession? Will the environment remain a central concern? Will people still be willing to invest time and money in 'green' technologies, products, and practices?

I also wonder how this emphasis on environmental concerns will impact curriculum and resource development. Will the provincial education branch respond and incorporate a stronger emphasis on environmental education in its soon-to-be-updated elementary science curriculum (a draft to be released 2009)? How might the environmental education NGOs be affected? Will their business prosper? Recently a government and industry funded environmental NGO began operating in Alberta and has developed *A Framework to Advance Environmental Education in Alberta* (Alberta Council for Environmental Education, 2007). Interestingly, the first reason listed in the framework's list of reasons why we need environmental education is: "Environmental education makes good business sense. Alberta's natural assets need to be managed

wisely. When citizens understand the issues, they can help ensure our natural capital is maintained for the benefit of future generations." (p. 3). When I read this opening statement I was disappointed. I had hoped this promising sounding environmental education organization might have a more biocentric ethic and approach. But the language—'business sense', 'natural assets', 'managed', and 'our natural capital'—perpetuate an anthropocentric and corporate model of environmental education and environmental responsibility. And so, I continue to wonder what the future will bring in terms of environmental education and practices—what these changes will mean for ecological literacy, environmental consciousness and citizenship, and sustainability.

A Final Reminiscence

My thesis began with an evocative description of a special place from my childhood—underneath an old wooden bridge alongside a small creek that runs through my grandparents' farm. I described the change to this place and my subsequent sense of loss and disturbance—this experience had a hand in shaping my own personal ecological identity. I very recently had the opportunity to revisit this place. I travelled to the farm to celebrate my grandmother's 100th birthday. She is still on her farm, dwelling in the house she and my grandfather built eighty years ago. The farm has changed over the years, and is very different from my memories of this place as a child and youth. How different it must be for my grandmother.

I went on a stroll around the property with my brother, sister, and cousins—a stroll along memory lane in many ways. I think all of us felt a sense of loss at the changes in the landscape. Some of the big old trees are gone. The barn and other out-buildings are badly sagging and showing their age, and some have disappeared, necessarily torn down

by my uncle. The paths down to the creek are overgrown and the creek itself has been altered by the beavers, which have had a much freer reign of the property since the passing of my grandfather many years ago. But as we reminisced and wandered down the now overgrown path to the creek behind the barn—a path my grandmother used to drive the dairy cattle down to water twice each and every day—I could not help but marvel at nature's ability to reclaim her own. The forest is slowly moving in, repossessing the pathway; the rusting axle of an old hay wagon is slowly being covered over by plant growth, hidden more and more from view; the beaver's work has altered the ford across the creek—it is difficult to imagine crossing the creek as we used to do to get to the back field. And while I felt a sense of loss and sadness at these changes, I also felt both a sense of humility and hope. Change is not only possible, it seems inevitable. "If we could only step aside and trust in nature, life will find a way" [John Hammond in *The Lost World: Jurassic Park* (Molen & Wilson, 1997)]. Or, since I do not imagine humankind can step aside, if we can be more humble and recognise that humans are not ultimately in control—Earth's systems are far too complex to be controlled—we might move toward a more holistic and integrated understanding and relationship with Earth and her systems, of which we are but a part.

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APPENDIX A: BIBLIOGRAPHY OF INSTRUCTIONAL RESOURCES

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APPENDIX B: INTERVIEW QUESTIONS

1. How did you come to be working here in your present capacity? How long?
2. How would you describe your role in resource production? Primary writer? Editor? Production manager?
3. What is your background? Educational? Experience?
4. What supports do you have to help you in your work? Other writers? Pedagogical support? Scientific expertise?
5. How do you research the information to present? What sources do you consult?
6. Why do you think the production of these materials is needed?
7. How do you decide what information to include when you develop a curriculum resource? What are the criteria [guidelines] for resource production?
8. What principles or ideas do you keep in mind when writing or producing the resources?
9. What are your criteria for evaluation of the materials? Field-tested? Reviewed? Scientific accuracy?
10. Do you have final say for the end product? Who does?
11. What are your organization's marketing/promotion strategies?
12. Do you think teacher professional development is needed? Why or why not?
13. Who sponsors the production of these resources? Is there more than one sponsor?
14. What are the interests of the sponsors?
15. Do you think this impacts the direction of the work?
16. Anything further you would like to add?

APPENDIX C: SAMPLE INSTRUCTIONAL RESOURCE DATA MATRIX

Electricity [Poster]	View of Nature	Human-nature relationship
Presentational	(Front) logically connected attributes (topological) conjoined by roads—symbolic of our (human) access to/control of all parts of the world e.g. "Power for the People" [conceptual process – analytical structure] (Inside) view of nature is eco/biomechanistic – cutaway diagrams focus on bits & pieces – the use of arrows creates a connection from one piece to other – flowchart type diagram [classificational process]	(Front) Natural wilderness area – smiling animals (bear, deer) – electrical towers running through (we touch/affect all parts, even wilderness areas but without negative effects, i.e. happy animals) (Inside) strong use of vectors – indicates events (processes) but humans are removed – machines do everything – omission of who; chaining of events
Orientational	(Front) contact – offer (participants do not directly gaze at viewer) Social distance – impersonal (no close ups) Attitude – objectivity – knowledge orientation Slight top-down perspective – essence of viewer power	(Front) abstract analytical visual – low modality from a naturalistic point of view Inclusion of 'cutesy' cartoonish animals used to involve viewer emotionally – esp. used in earlier years with children
Organizational	(Back) Electricity story – information oriented (overt generic structure of a report) – largest piece of text.	(Front) bright colours (indicates salience) are humans dominant? (Back) Electricity circuit diagram – [ideal] most highly valued/high salience – decontextualized House/humans – [real] less highly valued - decontextualized

Electricity [Poster]	Uncertainty	Multiple perspectives/ bias-balance	Ecological literacy dimensions
Presentational		(Front) Presents all types of energy sources – frame sizes are different – suggests importance? (Inside) different electricity sources represented on abstract 'map' of Canada (Inside) inclusion of text/article on climate change indicates another perspective	(Back) overt taxonomy [classificational] - informational, functional dimension (Inside) flowchart structure & framing informational – functional (Front) presents different Canadian cultural contexts – cold north, etc. - cultural
Orientational	(Front) representative drawings are unrealistic, cartoonish – lower modality Interspersed with framed photos of 'real' images of energy production sources – higher modality	(Front) [ideal] most highly valued top section is dominated by brown/industry Green (agriculture, forested areas) [real] less highly valued; low salience (Front) Beaver/forester – centre of poster; orange is salient; presents a questioning or uncertain perspective, i.e. puzzled expression of beaver; 'ignoring' human	(Front) [attitude] objectivity – knowledge orientation – functional (Front) – 'lookout' position on the landscape – not a part of the landscape but an over-view
Organizational	Poster has 3 views: Front – abstract map of different sources of energy Back – schematics of house & electricity generation; 'electricity story' Inside – integration of electricity into society; flowchart diagrams of electricity production		(Inside) Framing of stages of electricity production & heading suggests a hierarchical, flowchart structure – cause & effect links - functional

APPENDIX D: GLOSSARY

Composition: Composition (organizational metafunction) relates the representational (presentational) and interactive (orientational) meanings of an image to each other through three interrelated systems: information value (placement of elements that relate them to each other or to the viewer, giving them specific informational value), salience (degree an element attracts the viewer's attention), and framing (presence or absence of framing devices that disconnect or connect image elements) (Kress & van Leeuwen, 2006).

Conceptual representations: Ideational (presentational) visual representation structures which are conceptual, that is, represent participants in terms of their more generalized and more or less stable and timeless essence, through classificational, analytical or symbolic processes (Kress & van Leeuwen, 2006).

Classificational processes relate participants to each other in terms of a 'kind of' relation, a taxonomy, which involves subordinates in relation to at least one superordinate participant. Classificational image structures are realized through covert or overt taxonomies (Kress & van Leeuwen, 2006).

Analytical processes relate participants in terms of a part-whole structure and involve two kinds of participants—carrier (the whole) and any number of possessive attributes (the parts). Analytical structures are realized through structured or unstructured processes. Structured processes can be spatial or temporal (i.e. time line). Analytic image structures can be further described by type of process (exhaustive or inclusive), accuracy (topographical or topological) and abstraction (concrete or abstract) (Kress & van Leeuwen, 2006).

Symbolic processes are about what a participant means or is, and are realized through attributive or suggestive symbolic structures (Kress & van Leeuwen, 2006).

Deixis: In linguistics, deixis refers to "the function or use of deictic words or forms." Deictic "denotes a word or expression, whose meaning is dependent on the context in which it is used (such as *here* or *next week*)" (*Concise Oxford English Dictionary*, 2002). For example, in the sentence 'Our forests have rules that must be followed', the word *our* is deictic because the determination of its referent depends on who 'says' that sentence. The function of the deictic word *our* is possessive, thus it can be characterised as an example of possessive deixis.

Grammatical metaphor: Grammatical metaphor involves a reshaping of experience through grammar; the relationship between the grammar and the semantics is recast. In a traditional notion of semantic metaphor, the grammatical structure may be the same but the meaning is in some way different. For example, *the iron horse charged along the rails* for *the steam engine travelled down the tracks*. In grammatical metaphor, the grammatical structure or form is changed though the meaning is intended to remain the same. For example, "The rapid increase in greenhouse gases over the past sixty years is thought to be contributing to global warming and climate change" (*Energy Literacy Series*, Petroleum module). The process (verb) *increase* (to make larger) is recast as an entity (noun); the process (verb) *contribute* (to be a partial cause of something) is recast as a quality (adjective). Grammatical metaphor refers to non-congruent means for encoding language, most often through nominalization (see below) (Halliday, 2004).

Interactive meanings: The interactive (orientational) dimension represents the relation or interaction between the producer of an image and the viewer. Interactive meanings in images are realized through contact (demand or offer), social distance (intimate/personal, social or impersonal), and attitude, which can be subjective (involvement or detachment; and viewer power, equality or representation power) or objective (action or knowledge orientation) (Kress & van Leeuwen, 2006).

Modality: Modality, which relates to the orientational metafunction, can be described in linguistic or visual terms. Modality relates to 'reality' or truth claims and indicates certainty, possibility, desire, affect, obligation, belief or probability.

Linguistic modality relies on syntax or modality markers such as modal verbs (*may, will* and *must*), adjectives (*possible, probable* and *certain*) or adverbs (*perhaps, probably* and *certainly*).

Visual modality in images also relies on modality markers. However, what is viewed as 'real' depends on a particular social group's definition of reality. Usually, visual realism or visual modality is judged according to naturalism or photorealism. But there are exceptions. For example, in scientific or technical communities, black and white line drawings may have higher modality than a photograph. Visual modality markers include: colour saturation, differentiation, and modulation; contextualization; representation; depth; illumination; and brightness (Kress & van Leeuwen, 2006).

Narrative representations: Ideational (presentational) visual representation structures which are narrative, that is, present unfolding actions and events, processes of change, and transitory spatial arrangements. Narrative processes always include

vectors, which are formed by depicted elements that construct an oblique line. Vectors indicate directionality and action, connecting participants. Narrative visual structures may represent circumstances (e.g. setting, means, or accompaniment) or processes. Processes may be agentive or non-agentive. Agentive processes may be projective (e.g. mental or verbal processes) or non-projective (e.g. transactional or non-transactional action processes or non-transactional reaction processes) (Kress & van Leeuwen, 2006).

Nominalization: Nominalization is the predominant form of grammatical metaphor and involves recasting processes (verbs), qualities (adjectives), and circumstances (adverbs or prepositional phrases) as entities, that is, as nouns or nominal groups. Nominalization creates a shift towards the concrete and stable or enduring over time (Halliday, 2004).

APPENDIX E: INTERVIEW ANALYSIS THEMATIC CODEBOOK

Level			
1	2	3	Theme
1.00			**Educational/experiential background of participants**
	1.10		Pedagogical
		1.11	Education degree – Elementary, secondary, major, minor
		1.12	Teaching/classroom experience
	1.20		Science
	1.30		Managerial
	1.40		Other
2.00			**Role of participant in resource production**
	2.10		Writer only
	2.20		Project manager/coordinator only – oversees resource production
	2.40		Other/multiple roles
3.00			**Place/role/structure of organization in resource production**
	3.10		Subcommunity of organization, i.e. government, NGO, industry, ENGO – Where do they position themselves? Has it changed?
	3.20		Raison d'être – What is their reason for existence? What do they do?
		3.21	Create/provide resources for classroom teachers
		3.22	Teacher professional development
		3.23	Direct delivery of programs for children/youth
		3.24	Provide expertise/knowledge, i.e. speakers
		3.25	National reach/program (not just Alberta)
		3.26	Provide funding to others
4.00			**Partnership/Sponsorship**
	4.10		Corporate involvement in resource production
	4.20		Other partnerships/relationships – **reciprocal relationship/partnership**
	4.30		Funding sources – Where do the monies for resource production/teacher PD come from? – **Sponsorship**
		4.31	Imbalance in funding/representation, i.e. environmental groups do not have the resources that industry do
	4.40		Impact of partnerships, i.e. influence content, etc.
5.00			**Supports for resource production, i.e. experts**
	5.10		Pedagogical
	5.20		Science/expert
	5.30		Writing
	5.40		Other
6.00			**Review/evaluation of resources**
	6.10		Teacher/pedagogical review, i.e. Field testing
	6.20		Expert review, i.e. scientific; subject matter experts
	6.30		Review by sponsors/partners
	6.40		Final approval process
7.00			**Marketing/promotion of material**
	7.10		Approach(es) used to market, i.e. teachers conventions, e-newsletters, brochures, websites, etc.

	7.20		Who do they market resources to, i.e. teachers, school districts, youth? Elementary? Secondary? Both?
	7.30		Cost of materials (connects to corporate/partnership involvement)
8.00			**Nature/environment**
	8.10		View of nature
	8.20		Human-nature relationship
9.00			**Multiple perspectives/bias-balanced**
	9.10		Represented within resource
	9.20		As views of writers/producers of resource
10.00			**Notion of uncertainty/certainty**
11.00			**Dimensions of ecological literacy**
	11.10		Functional, i.e. information, content knowledge, background
	11.20		Cultural, i.e. understanding/aware of particular nature context (Alberta); environmental issues and concerns
	11.30		Critical, i.e. decision-making, action
12.00			**View of learning/children/education**
	12.10		Education vs. advocacy
	12.20		Context based activities vs. content focused important for learning/ed.
	12.30		View of environmental education (not just education in general)
13.00			**View of teachers/teaching**
	13.10		Need for teacher professional development
		13.11	Teacher knowledge (e.g. need for resources to fill knowledge gap)
		13.12	Teacher confidence
		13.13	Connecting with educational community/teacher sharing of info., i.e. form of marketing
	13.20		Teacher's role, i.e. delivery of curriculum; nurturing children
	13.30		Teachers' beliefs and values re environment/environmental education
	13.40		Teacher accountability, i.e. to curriculum, PATs
	13.50		Teacher issues/difficulties or needs, i.e. need for resources for instructional support, etc. (different from lack of knowledge)
	13.60		Teachers as capable
	13.70		Teachers' views re corporate sponsorship in education
14.00			**Curriculum connections**
	14.10		Science primary place for environmental education
	14.20		Cross-curricular integration
	14.30		Curriculum links primary focus versus environmental issues
15.00			**The resources**
	15.10		Place of resource – Why are they needed?
	15.20		Features of resources – Criteria / guidelines for resource production / expensive to produce
	15.30		Resource use – Are they used by teachers? Meet teachers' needs?
	15.40		Drivers behind resource production
	15.50		Currency issues – need/difficulty keeping resources current
	15.60		Meet students' needs
16.00			**Language/messaging**
17.00			**Alberta context – political/social (not eco lit as in 11.20)**

Table 8
Living systems instructional resources: overview

Title	Date	Cost	Producer(s) / Sponsor(s)	Components	Curricular connections
Between the Stands	1999	Free (ordered kit)	Producers: • FEESA (now Inside Education) • Alberta Forest Products Association (AFPA) • Alberta Environment	• Teachers' Guide • Colour poster • 'Banner' – student text resource	Developed for Div II (Grades 4-6): Grade 4 Science – Topic E: Plant Growth & Changes (SLE 1) Grade 5 Social Studies – Topic A (outdated curriculum) Grade 6 Science – Topic E: Trees & Forests (SLEs 1, 2, 4, 5, 6, 8, 9 , 10)
Envirokids Investigate Forest Health	2001 rev. 2006	Free (can be ordered or printable online PDF doc)	Producers: • Alberta Sustainable Resource Development • Alberta Environment	• Student text; black & white activity booklet (colour jacket)	Grade 6 Science – Topic E: Trees & Forests Grade 7 Science – Unit A: Interactions & Ecosystems Unit B: Plants for Food & Fibre
Envirokids Investigate Forest Health – Teachers' Utilization Guide	2004	Free (printable online PDF doc)	Producers: • Alberta Sustainable Resource Development • Alberta Environment	• Teachers' guide	Grade 6 Science – Topic E: Trees & Forests Grade 7 Science – Unit A: Interactions & Ecosystems Unit B: Plants for Food & Fibre
Trees and Forests	1996	$34.00 (avail. from EPSB distribu-tion centre)	Producer: • Edmonton Public Schools	• Teachers' instructional resource with lesson plans and student black-line masters (work sheets)	Grade 6 Science – Topic E: Trees & Forests

Table 9
Nonliving systems instructional resources: overview

Title	Date	Cost	Producer(s) / Sponsor(s)	Components	Curricular connections
Electricity	2005	Free – (ordered kit)	Producer: • Inside Education Sponsors (primary): • Canadian Centre for Energy Information • Alberta Government • EPCOR	• Teachers' Guide & Activities (lesson plans) for Students • Colour poster • Electricity Kit Resource CD	Social Studies: Grades 4, 5 & 8 (all Topic A outcomes) Science: Grade 5 (Topic A & B), Grade 7 (Topic C), & Grade 9 (Topic D)
Science 5: Electricity All Around Us	2003/ 2007	Free – (online website and student interactives – teachers' guide and student sheets printable)	Producer: • Pembina Institute Sponsors (primary): • Alberta Environment • BP • PetroCanada • Suncor • TransCanada	• Student resource and login • Teachers' resource and login	Grade 5 Science – Topic A: Electricity & Magnetism & Topic B: Mechanisms Using Electricity
Energy Literacy Series	2005	Free – (online website and student interact-tives)	Producers: • SEEDS Foundation (primary producer) • Canadian Centre for Energy Information (co-producer / sponsor)	• Student resource – 10 modules addressing 10 different energy sources	National Curricular connections; Grades 6 to 12 Physical Science and Earth & Space Science